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Part 2 SITE SAFETY ANALYSIS REPORT

Chapter 1 Introduction and General Description

1.1 Introduction

This Site Safety Analysis Report (SSAR) supports Southern Nuclear Operating Company's (SNC's or Southern Nuclear's) Early Site Permit (ESP) application. The SSAR addresses site suitability issues and complies with the applicable portions of Title 10, Part 52 of the Code of Federal Regulations (10 CFR 52), Subpart A*, Early Site Permits*.

The site selected for the ESP is the Vogtle Electric Generating Plant (VEGP) site in eastern Burke County, Georgia; approximately 26 miles southeast of Augusta, Georgia and 100 miles northwest of Savannah, Georgia; directly across the Savannah River from the US Department of Energy's Savannah River Site in Barnwell County, South Carolina. VEGP Units 1 and 2, two Westinghouse Electric Company, LLC (Westinghouse) pressurized water reactors (PWRs), each with a thermal power rating of 3565 megawatts thermal (MWt), are located on the VEGP site. VEGP Units 1 and 2 have been in commercial operation since 1987 and 1989, respectively. Plant Wilson, a six-unit oil-fueled combustion turbine facility owned by Georgia Power Company (GPC), is also located on the VEGP site.

SNC has selected the Westinghouse AP1000 certified reactor design for the VEGP ESP application. The AP1000 has a thermal power rating of 3,400 MWt, with a net electrical output of 1,117 megawatts electrical (MWe) **(Westinghouse 2005)**. Two units are proposed, with projected commercial operation dates of May 2015 and May 2016, respectively.

The ESP units, VEGP Units 3 and 4, are adjacent to and west of the existing VEGP units.

The existing VEGP units are co-owned by Georgia Power Company, Oglethorpe Power Corporation, the Municipal Electric Authority of Georgia, and the City of Dalton, Georgia, an incorporated municipality in the State of Georgia acting by and through its Board of Water, Light and Sinking Fund Commissioners ("Dalton Utilities"). SNC is the licensed operator of the existing facilities at the VEGP site, with control of the existing facilities, including complete authority to regulate any and all access and activity within the plant exclusion area boundary. SNC has been authorized by GPC, acting as agent for the other owners (also known as co-owners) of the existing VEGP, to apply for an ESP for the VEGP site. SNC has no ownership interest in the VEGP.

GPC and SNC are subsidiaries of Southern Company, and SNC is the licensed operator for all Southern Company nuclear generating facilities. SNC's business purpose is management and operation of nuclear generating facilities owned or co-owned by Southern Company subsidiaries. SNC ESP Application Part 1, *Administrative Information*, Chapter 3, provides additional information about Southern Company, GPC, VEGP co-owners, and SNC.

The SSAR discusses the design parameters, site characteristics, and site interface values for the two units that would form the basis for NRC's issuance of an ESP. The SSAR also contains information about site safety, emergency preparedness, and quality assurance. The following paragraphs briefly describe the contents of the SSAR:

- Chapter 1, Introduction and General Description, includes a general site description; an overview of the AP1000; the design parameter, site characteristic, and site interface value approach; and a summary of regulatory compliance (CFR, Regulatory Guides, and NUREG-0800/RS-002).
- Chapter 2, Site Characteristics, includes geography and demography; nearby industrial installations; transportation and military facilities; and meteorologic, hydrologic, geologic, and seismic characteristics of the site. It also includes descriptions of effluents; thermal discharges; and conformance with 10 CFR 100, *Reactor Site Criteria*, requirements.
- Chapter 3, Design of Structures, Components, Equipment, and Systems, contains information in Section 3.5.1.6 on aircraft hazards.
- Chapter 13, Conduct of Operations, includes emergency planning and industrial security information.
- Chapter 15, Accident Analyses, includes accident and dose consequence analyses required by 10 CFR 52.17(a)(1), 10 CFR 50.34(a)(1), and 10 CFR 100.21(c)(2).
- Chapter 17, Quality Assurance, includes the Quality Assurance Program (QAP) under which the ESP application has been prepared. The QAP also addresses ESP activities prior to Combined Operating License (COL) receipt, such as site preparation, earthwork, preconstruction activities, and procurement.

1.2 General Site Description

1.2.1 Site Location

The 3,169-acre VEGP site is located on a coastal plain bluff on the southwest side of the Savannah River in eastern Burke County. The site exclusion area boundary (EAB) is bounded by River Road, Hancock Landing Road and 1.7 miles of the Savannah River (River Miles 150.0 to 151.7). The property boundary entirely encompasses the EAB and extends beyond River Road in some areas. The site is approximately 30 river miles above the U.S. 301 bridge and directly across the river from the Department of Energy's Savannah River Site (Barnwell County, South Carolina). The VEGP site is approximately 15 miles east-northeast of Waynesboro, Georgia and 26 miles southeast of Augusta, Georgia, the nearest population center (i.e., having more than 25,000 residents). It is also about 100 miles from Savannah, Georgia and 150 river miles from the mouth of the Savannah River. Numerous small towns exist within 50 miles of the site. A major Interstate highway, I-20, crosses the northern portion of the 50-mile radius. Access to the site is via US Route 25; Georgia Routes 56, 80, 24, 23; and New River Road. A navigation channel is authorized on the Savannah River from the Port of Savannah to Augusta, Georgia. A railroad spur connects the site to the Norfolk Southern Savannah-to-Augusta track.

Figures 1-1 and 1-2 show the site location and a 6-mile and 50-mile radius, respectively.

1.2.2 Site Development

The VEGP site currently has two Westinghouse pressurized water reactors (PWRs), rated at 3,565 MWt, and their supporting structures. These structures include two natural-draft cooling towers (one per unit), associated pumping and discharge structures, water treatment building, switchyard, and training center. Plant Wilson, a six-unit oil-fueled combustion turbine facility, is also located on the VEGP site. Figure 1-3 shows the current VEGP site plan.

The new plant footprint selected for the ESP is adjacent to the west side of the VEGP Units 1 and 2, and is generally the area that was originally designated for VEGP Units 3 and 4 when the plant was first proposed for construction. The footprint is shown on Figure 1-4.

SNC has selected the Westinghouse AP1000 certified reactor design for the ESP application. SSAR Section 1.3 identifies the design parameters, site characteristics, and site interface values that form the permit basis for NRC's issuance of an ESP. The design parameters are based on the addition of two Westinghouse AP1000 units, to be designated Vogtle Units 3 and 4. Each unit represents a portion of the total generation capacity to be added and will consist of one reactor with a thermal power rating of 3,400 MWt and a net electrical output of 1,117 MWe **(Westinghouse 2005)**. The layout and arrangement of the proposed new units are shown in Figure 1-5.

1.3 Site Characteristics, Design Parameters, and Site Interface Values

The required contents of an ESP application are specified in 10 CFR 52.17. As detailed in 10 CFR 52.17(a)(1), the application is required to specify, among other things, the number, type, and thermal power level of the facilities; boundaries of the site and proposed general location of each facility; type of cooling systems, intakes, and outflows; anticipated maximum levels of radiological and thermal effluents; site seismic, meteorological, hydrologic, and geologic characteristics; and existing and projected future population profile of the area surrounding the site. The SNC approach to providing this information is presented in the following subsections.

1.3.1 Site Characteristic, Design Parameters, and Site Interface Value Approach

The list of plant parameters necessary to define the plant-site interface was developed in the early 1990s based on work sponsored by the US Department of Energy (DOE) and the nuclear industry, which included reactor vendors and utilities. The effort was intended to provide a comprehensive list of plant parameters to accurately characterize a plant at a site. Over time, this list evolved to encompass information needed to support development of an ESP application, including the SSAR and the Environmental Report.

During 2002, *Site Characteristic* and *Design Parameter* terminology was discussed in several public meetings involving the NRC and nuclear industry representatives as part of the resolution of Generic Topic ESP-6 (*Plant Parameters Envelope Approach for ESP*) and was the subject of associated correspondence between the NRC and the Nuclear Energy Institute (NEI). Definitions of these terms are now proposed in the NRC staff's draft amendment to 10 CFR 52. *Site Characteristics* are the actual physical, environmental, and demographic features of a site. These values are established through data collection and/or analysis and are reported in an ESP application. They are developed in accordance with NRC requirements and guidance and form the basis for comparison with the design characteristics of the selected plant to verify site suitability for that design. *Design Parameters* are the postulated features of a reactor or reactors that could be built at a proposed site. These features describe plant design information that is necessary to prepare and review an ESP application. The SNC approach evaluates the AP1000 reactor design and the VEGP site to identify the *Site Characteristics* and *Design Parameters*. In a COL application, the AP1000 site-specific engineering and design features will be compared with the ESP parameters to demonstrate they are bounded.

SNC has further defined *Site Interface Values* as those values that have been determined based on the specific interrelationships between select site characteristics and plant design parameters. Examples include (1) cooling system evaporation rate, which is dependent on both design heat rejection rate and the environmental characteristics of the heat sink, and (2) gaseous radioactive dose consequences, which are dependent on the plant design source terms and the site air dispersion characteristics. Similar to above, *Site Interface Values* will be evaluated at COL application to demonstrate they are bounded by the ESP analysis.

An overview of the AP1000 PWR design and a more detailed discussion of the implementation of the *Site Characteristic–Design Parameter* approach are presented below.

1.3.2 Overview of Reactor Type

The AP1000 PWR design, with a thermal power rating of 3,400 MWt, developed by Westinghouse, has been selected for evaluation in this ESP application.

In January 2006, the NRC issued the Westinghouse AP1000 Design Certification Final Rule under 10 CFR 52, Appendix D. The AP1000 is a two-loop, four-reactor-coolant-pump PWR that uses fuel, a reactor vessel, and internals similar to those in service today at South Texas Project. The reactor coolant pumps are canned pumps to reduce the probability of leakage and to improve reliability.

The AP1000 is designed to use passive features for accident mitigation. An externally cooled steel containment building, in-containment refueling water storage tank, rapid depressurizing capability, and other design features preclude the need for safety-related electrical alternating-current-powered equipment used by the current nuclear fleet. Electrical power generation is through the use of a standard steam turbine cycle.

The AP1000 is designed in a single-unit, stand-alone configuration.

1.3.3 Use of the Site Characteristics, Design Parameters, and Site Interface Values Table

The *Site Characteristics, Design Parameters, and Site Interface Values* table (Table 1-1) provides a summary list of the limiting site characteristic values that have been established by analyses presented throughout the SSAR. This list also provides a summary of important site characteristics necessary to establish the findings required by 10 CFR Parts 52 and 100 on the suitability of the proposed ESP site. This list is intended to support development of the *Site Characteristics and Plant Design Parameters for the Early Site Permit* table, as defined by the NRC **(NRC-NEI 2004)**. Table 1-1 further provides a list of limiting design parameters and assumptions involving the design of a nuclear power plant that may be constructed on the ESP site in the future, in order to assess site characteristics.

Table 1-1 is divided into three parts. Part I, Site Characteristics, includes the data that is specific to the ESP site. Part II, Design Parameters, includes information supplied by the reactor vendor, Westinghouse, for the AP1000 plant design. Part III, Site Interface Values, includes the values that have been determined based on the interrelationship of certain site characteristics and design parameters. The table includes a summary description of each item and a reference to the SSAR section(s) in which more detailed information can be found. Where two-unit values are different from one-unit values, the two-unit value is included in brackets [ ].

Since certain support system designs, such as cooling towers, have not yet been completed, the data in this table are based on design requirements and interface information from the reactor vendor, Westinghouse.

1.4 Identification of Agents and Contractors

SNC has selected Bechtel Power Corporation (Bechtel) as its principal contractor to assist with preparing the SSAR portion of the ESP application and Tetra Tech NUS, Inc. (TtNUS), to assist with preparing the Environmental Report portion. Bechtel and TtNUS have supplied personnel, systems, project management, and resources to work on an integrated team with SNC.

1.4.1 Bechtel Corporation

Bechtel is the nation's largest power contractor and is headquartered in San Francisco. Bechtel has a history of supporting the nuclear power industry, beginning with the construction in 1950 of the EBR-1 reactor. Since then, Bechtel has engineered and constructed more than 60,000 MWe of nuclear power capacity worldwide. Bechtel currently has approximately 40,000 employees working on 400 projects in 47 different countries around the globe.

1.4.2 Tetra Tech NUS, Inc.

TtNUS is an environmental and engineering consulting company with a history of service to the nuclear power industry since the inception of its predecessor company, Nuclear Utility Services (NUS) Corporation in 1960. TtNUS currently has 20 offices and approximately 700 employees throughout the country. TtNUS is a wholly owned subsidiary of Tetra Tech, Inc., which has approximately 9,000 employees worldwide.

1.4.3 Other Contractors

In addition to Bechtel and TtNUS, contractual relationships were established with several specialized consultants to assist in developing the ESP application.

1.4.3.1 MACTEC Engineering and Consulting, Inc.

MACTEC Engineering and Consulting, Inc., performed geotechnical field investigations and laboratory testing in support of SSAR Section 2.5, Geology, Seismology, and Geotechnical Engineering. That effort included performing standard penetration tests; obtaining core samples and rock cores; performing cone penetrometer tests, downhole geophysical logging, and laboratory tests of soil and rock samples; installing ground water observation wells; and preparing a data report.

1.4.3.2 William Lettis & Associates, Inc.

William Lettis & Associates, Inc., performed geologic mapping and characterized seismic sources in support of SSAR Section 2.5, including literature review, geologic field reconnaissance, review and evaluation of existing seismic source characterization models, identification and characterization of any new or different sources, and preparation of the related SSAR sections.

1.4.3.3 Risk Engineering, Inc.

Risk Engineering, Inc., performed probabilistic seismic hazard assessments and related sensitivity analyses in support of SSAR Section 2.5. These assignments included sensitivity analyses of seismic source parameters and updated ground motion attenuation relationships, development of updated Safe Shutdown Earthquake ground motion values, and preparation of the related SSAR sections.

1.5 Requirements for Further Technical Information

No technical information development programs remain to be performed to support this application.

1.6 Material Incorporated by Reference

No material has been incorporated by reference in this application.

1.7 Drawings and Other Detailed Information

No such information has been submitted separately as part of this application.

1.8 Conformance to NRC Regulations and Regulatory Guidance

This section discusses the conformance of the ESP application SSAR with applicable NRC regulations and guidance. NRC regulations are contained in Title 10 of the Code of Federal Regulations. NRC guidance is contained in NRC Regulatory Guides (RGs) and in NRC Review Standard RS-002, Processing Applications for Early Site Permits.

Clarifications are identified when guidance is met, but additional information is needed to provide complete understanding of the method of conformance. In certain instances, regulations and regulatory guides do not apply due to design features not being applicable or due to process timing (i.e., applies at COL application versus ESP application).

Conformance with NRC regulations, Regulatory Guides, and Review Standard RS-002 is summarized in Table 1-2. A matrix of ESP sections confirms compliance with each regulatory requirement. The revision number and date are provided for applicable Regulatory Guides. Clarification explanations are provided in Table 1-3.

Table 1-1 Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Precipitation		
Maximum Rainfall Rate	19.2 inches in 1 hr 6.2 inches in 5 min	PMP for 1-hr and 5-min duration of precipitation at the site. Refer to Table 2.4.2-3 and Figure 2.4.2-4
100-Year Snow Pack 48-Hour Winter Probable Maximum Precipitation (PMP)	10 lb/sq ft 28.3 in.	Weight, per unit area, of the 100-year return period snowpack at the site Maximum probable winter rainfall in 48-hour period. Refer to Section 2.3.1.3.4
Seismic		
Design Response Spectra	Values specified and illustrated in Section 2.5.2	Site-specific response spectra. Refer to Section 2.5.2 and Figure 2.5.2-44.
Capable Tectonic Structures or Sources	No fault displacement potential within the investigative area	Conclusion on the presence of capable faults or earthquake sources in the vicinity of the plant site. Refer to Sections 2.5.1.1.4, 2.5.1.2.4, and 2.5.3; Table 2.5.3-1
Water		
Maximum Flood (or Tsunami)	178.10 ft msl	Water level at the site due to dam breach. Refer to Sections 2.4.2.2, 2.4.3.4, 2.4.4.3, and 2.4.10;
Maximum Groundwater	165 ft msl	Site basis for subsurface hydrostatic loading due to difference in elevation between the site grade elevation in the power block area and the maximum site groundwater level. Refer to Sections 2.4.12.4 and 2.5.4.6.1

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Subsurface Material Properties		
Liquefaction	None at site-specific SSE. Compacted structural fill will provide an adequate safety factor against liquefaction (min 1.9-2.0).	Liquefaction potential for subsurface material at the site. Refer to Section 2.5.4.8
Minimum Bearing Capacity (Static)	Values in Figure 2.5.4-13	Allowable load-bearing capacity of the layer supporting plant structures. Refer to Sections 2.5.4.10.1 and 2.5.4.11; Figure 2.5.4-13
Minimum Shear Wave Velocity	Values in Tables 2.5.4-10 and 2.5.4-11	Propagation velocity of shear waves through the foundation materials. Refer to Section 2.5.4.7.1; Tables 2.5.4-10, and 2.5.4-11; Figures 2.5.4-6, 2.5.4-7, and 2.5.4-8
Tornado		
Maximum Pressure Drop	2.0 psi	Decrease in ambient pressure from normal atmospheric pressure at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2
Maximum Rotational Speed	240 mph	Rotation component of maximum wind speed at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2
Maximum Translational Speed	60 mph	Translation component of maximum wind speed at the site due to the movement across ground of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Maximum Wind Speed	300 mph	Sum of the maximum rotational and maximum translational wind speed components at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2
Radius of Maximum Rotational Speed	150 ft	Distance from the center of the tornado at which the maximum rotational wind speed occurs at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2
Maximum Rate of Pressure Drop	1.2 psi/sec	Maximum rate of pressure drop at the site due to passage of a tornado having a probability of occurrence of 10^{-7} per year. Refer to Section 2.3.1.3.2
Wind		
Basic Wind Speed	104 mph	Three-second gust wind velocity, associated with a 100-year return period, at 33 ft (10 m) above ground level in the site area. Refer to Section 2.3.1.3.1
Selected Site Characteristic Ambient Air Temperatures		*(Site characteristic wet bulb and dry bulb temperatures associated with listed exceedance values and 100-year return period)*
Maximum Dry Bulb • 2% annual exceedance • 0.4% annual exceedance • 100-year return period	 92°F 97°F 115°F	Refer to Section 2.3.1.5

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Minimum Dry Bulb • 1% annual exceedance • 0.4% annual exceedance • 100-year return period	 25°F 21°F -8°F	Refer to Section 2.3.1.5
Maximum Wet Bulb • 0.4% annual exceedance • 100-year return period	 79°F 88°F	Refer to Section 2.3.1.5
Airborne Effluent Release Point		
Atmospheric Dispersion (χ/Q) (Accident)		
0-2 hr @ Exclusion Area Boundary (EAB) 0-8 hr @ Low Population Zone (LPZ) 8-24 hr @ LPZ 1-4 day @ LPZ 4-30 day @ LPZ	3.11E-04 sec/m^3 6.25E-05 sec/m^3 4.70E-05 sec/m^3 2.53E-05 sec/m^3 1.04E-05 sec/m^3	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases. The atmospheric dispersion values presented represent typical site parameter values assumed by reactor vendors. Refer to Section 2.3.4.2; Table 15-11.
Atmospheric Dispersion (χ/Q) (Routine Release)		
Annual Average Undepleted/No Decay χ/Q Value @ EAB	5.4E-06 sec/m^3	The maximum annual average EAB undepleted/no decay atmospheric dispersion factor (χ/Q) value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Section 2.3.5.2; Table 2.3-17
Annual Average Undepleted/ 2.26-Day Decay χ/Q Value @ EAB	5.4E-06 sec/m^3	The maximum annual average EAB undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Annual Average Depleted/ 8.00-Day Decay χ/Q Value @ EAB	4.9E-06 sec/m^3	The maximum annual average EAB depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average D/Q Value @ EAB	1.7E-08 1/m^2	The maximum annual average EAB relative deposition factor (D/Q) value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Resident	2.5E-06 sec/m^3	The maximum annual average resident undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Section 2.3.5.2; Table 2.3-17
Annual Average Undepleted/ 2.26-Day Decay χ/Q Value @ Nearest Resident	2.4E-06 sec/m^3	The maximum annual average resident undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average Depleted/ 8.00-Day Decay χ/Q Value @ Nearest Resident	2.2E-06 sec/m^3	The maximum annual average resident depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average D/Q Value @ Nearest Resident	9.4E-09 1/m^2	The maximum annual average resident D/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Meat Animal	6.4E-07 sec/m^3	The maximum annual average meat animal undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Section 2.3.5.2; Table 2.3-17
Annual Average Undepleted/ 2.26-Day Decay χ/Q Value @ Nearest Meat Animal	6.4E-07 sec/m^3	The maximum annual average meat animal undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average Depleted/ 8.00-Day Decay χ/Q Value @ Nearest Meat Animal	5.5E-07 sec/m^3	The maximum annual average meat animal depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average D/Q Value @ Nearest Meat Animal	1.6E-09 1/m^2	The maximum annual average meat animal D/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average Undepleted/No Decay χ/Q Value @ Nearest Vegetable Garden	3.3E-07 sec/m^3	The maximum annual average vegetable garden undepleted/no decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average Undepleted/ 2.26-Day Decay χ/Q Value @ Nearest Vegetable Garden	3.3E-07 sec/m^3	The maximum annual average vegetable garden undepleted/2.26-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Annual Average Depleted/ 8.00-Day Decay χ/Q Value @ Nearest Vegetable Garden	2.7E-07 sec/m^3	The maximum annual average vegetable garden depleted/8.00-day decay χ/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Annual Average D/Q Value @ Nearest Vegetable Garden	8.7E-10 1/m^2	The maximum annual average vegetable garden D/Q value for use in determining gaseous pathway doses to the maximally exposed individual. Refer to Table 2.3-17
Population Density		
Population Center Distance	Approximately 26 mi (Augusta, GA)	The minimum allowable distance from the reactor(s) to the nearest boundary of a densely populated center containing more than about 25,000 residents (not less than one and one-third times the distance from the reactor(s) to the outer boundary of the LPZ) (i.e., 2-2/3 mi for VEGP). Refer to Sections 1.1, 1.2.1, 2.1.1, 2.1.3.2, and 2.1.3.5
Exclusion Area Boundary (EAB)	See Figure 1-4	The area surrounding the reactor(s), in which the reactor licensee has the authority to determine all activities, including exclusion or removal of personnel and property from the area. Refer to Sections 2.1.1, 2.1.2, and 2.3.4.1; Figure 1-4
Low Population Zone (LPZ)	A 2-mile-radius circle from the midpoint between the containment buildings of Units 1 and 2.	The area immediately surrounding the exclusion area that contains residents. Refer to Sections 2.1.3.4, 2.3.4.1, 2.3.4.2, and 2.3.5.1; Table 2.3-15

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part I Site Characteristics		
Item	**Value**	**Description and Reference**
Dose Calculation EAB	See Figure 1-4	A circle extending ½ mi beyond the power block area circle (775-ft radius circle encompassing Units 3 and 4). Total radius is 3,415 ft from the centroid of the power block circle. Dose Calculation EAB is completely within the actual plant EAB and is used to conservatively determine χ/Q values and subsequent accident radiation doses. Refer to Sections 2.3.4.1, 2.3.4.2, and 2.3.5.1; Tables 2.3-14, 2.3-16, and 2.3-17; Figure 1-4

Part II Design Parameters		
Item	**Single Unit [Two Unit] Value**	**Description and Reference**
Structures		
Height	234 ft 0 in.	The height from finished grade to the top of the tallest power blocks structure, excluding cooling towers (i.e., Containment Building). Refer to Section 2.3.3.3
Foundation Embedment	39 ft 6 in. to bottom of basemat from plant grade	The depth from finished grade to the bottom of the basemat for the most deeply embedded power block structure (i.e., Containment/Auxiliary Building). Refer to Sections 2.4.12 and 2.5.4.10
Airborne Effluent Release Point		
Gaseous Source Term (Post-Accident)	See Chapter 15 Tables	The activity, by isotope, contained in post-accident airborne effluents. Refer to Section 15.3; Tables 15-2 through 15-10

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part II Design Parameters		
Item	**Single Unit [Two Unit] Value**	**Description and Reference**
Release Point Elevation (Post-Accident)	Ground level	The elevation above finished grade of the release point for accident sequence releases. Refer to Section 2.3.4.1, 2.3.5.1, and 15.2; Tables 2.3-14 and 2.3-15
Plant Characteristics		
Megawatts Thermal	3,400 MWt [6,800 MWt]	The thermal power generated by one unit. Refer to Sections 1.1, 1.2.2, and 1.3.2

Part III Site Interface Values		
Item	**Single Unit [Two Unit] Value**	**Description and Reference**
Normal Plant Heat Sink		
Cooling Tower Make-up Flow Rate	28,892 gpm [57,784 gpm]	The maximum rate of removal of water from the Savannah River to replace water losses from the circulating water system. The bounding Makeup Flow Rate is a calculated value based on the sum of the expected evaporation rate at design ambient conditions plus the bounding blowdown flow rate and drift. Refer to Sections 2.4.8 and 2.4.11.5
Airborne Effluent Release Point		
Post-Accident Dose Consequences	10 CFR 100 10 CFR 50.34(a)(1)	The estimated design radiological dose consequences due to gaseous releases from postulated accidents. Refer to Chapter 15; Tables 15-12 through 15-22

Table 1-1 (cont.) Site Characteristics, Design Parameters, and Site Interface Values

Part III Site Interface Values		
Item	**Single Unit [Two Unit] Value**	**Description and Reference**
Minimum Distance to Site Boundary	3,420 ft	The minimum lateral distance from the release point (power block area circle) to the site boundary. Refer to Figure 1-4

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Table 1-2 Regulatory Compliance Matrix

Legend:
X = Complies
C = Clarification Required, See Table 1-3

Regulatory Requirements Document Title	Rev.	Date	Chapter 1	2.1.1	2.1.2	2.1.3	2.2.1 - 2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5	2.4.6	2.4.7	2.4.8	2.4.9	2.4.10	2.4.11	2.4.12	2.4.13	2.5.1	2.5.2	2.5.3	2.5.4	2.5.5	2.5.6	3.5.1.6	13.3	13.6	Chapter 15	Chapter 17
NRC Regulations																																					
10 CFR 20				X																														X			
10 CFR 20, Appendix B, Table 2																										X											
10 CFR 50.34(a)					X																																
10 CFR 50.34(a)(1)						X																														X	
10 CFR 50.34(a)(12)																												X									
10 CFR 50.34(b)(10)																												X									
10 CFR 50.47											X																										
10 CFR 50.47(b)(4)																																		X			
10 CFR 50.55a																					X		X								X						
10 CFR 50, Appendix A, GDC 2									X	X				X							X		X	X			X	X	X								
10 CFR 50, Appendix A, GDC 4									X																												
10 CFR 50, Appendix A, GDC 44																					X	X		X						X	X						
10 CFR 50, Appendix B																																					X
10 CFR 50, Appendix E											X	X	X																					X			
10 CFR 50, Appendix I				X							X		X																								
10 CFR 50, Appendix S IV(a)																												X									
10 CFR 50, Appendix S IV(b)																													X								
10 CFR 50, Appendix S IV(c)															X		X	X																			
10 CFR 52, Subpart A			X		X		X																			X	X	X	X	X	X	X					
10 CFR 52.17(a)														X	X			X	X	X	X	X	X	X	X												
10 CFR 52.17(a)(1)			X	X		X	X	X	X	X	X	X	X			X	X																X			X	
10 CFR 52.17(b)(1)																																		X			
10 CFR 52.17(b)(2)																																		X			
10 CFR 52.17(b)(3)																																		X			
10 CFR 52.18						X																															
10 CFR 52.24							X																														
10 CFR 73.55																																			X		
10 CFR 100																					X			X		X							X			X	
10 CFR 100.3					X	X																															
10 CFR 100, Subpart B				X		X																															
10 CFR 100.20							X					X	X																								
10 CFR 100.20 (b)								X																													
10 CFR 100.20(c)									X	X	X			X	X	X	X	X	X	X		X	X		X												
10 CFR 100.21(a)					X																																
10 CFR 100.21							X	X																													
10 CFR 100.21(c)(1)													X																								
10 CFR 100.21(c)(2)						X						X																								X	
10 CFR 100.21(d)									X	X	X														X												
10 CFR 100.21(f)																																			X		

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Table 1-2 (cont.) Regulatory Compliance Matrix

Legend: X = Complies C = Clarification Required, See Table 1-3 **Regulatory Requirements Document Title**	**Rev.**	**Date**	**Chapter 1**	**2.1.1**	**2.1.2**	**2.1.3**	**2.2.1 - 2.2.2**	**2.2.3**	**2.3.1**	**2.3.2**	**2.3.3**	**2.3.4**	**2.3.5**	**2.4.1**	**2.4.2**	**2.4.3**	**2.4.4**	**2.4.5**	**2.4.6**	**2.4.7**	**2.4.8**	**2.4.9**	**2.4.10**	**2.4.11**	**2.4.12**	**2.4.13**	**2.5.1**	**2.5.2**	**2.5.3**	**2.5.4**	**2.5.5**	**2.5.6**	**3.5.1.6**	**13.3**	**13.6**	**Chapter 15**	**Chapter 17**
10 CFR 100.23																									X		X	X	X	X	X						
10 CFR 100.23(c)																	X		X	X				X	X												
10 CFR 100.23(d)(4)																									X												
NRC Regulatory Guides																																					
NRC RG 1.23	Pr-1	Sep-80							X	X	X	X	X																								
NRC RG 1.27	2	Jan-76							X											X	X	X		X	X					X	X						
NRC RG 1.28	3	Aug-85																																			X
NRC RG 1.29	3	Sep-78													X	X	X	X	X	X	X		X														
NRC RG 1.59	2	Aug-77													X	X	X	X	X	X	X		X														
NRC RG 1.60	1	Dec-73																										C									
NRC RG 1.70	3	Nov-78	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	X	X
NRC RG 1.76 (DG-1143)	Pr-1	Jan-06							X																												
NRC RG 1.78	1	Dec-01					X	X				X																									
NRC RG 1.91	1	Feb-78					X	X																													
NRC RG 1.101	4	Jul-03																																X			
NRC RG 1.102	1	Sep-76													X	X	X	X	X	X	X		X														
NRC RG 1.109	1	Oct-77											X																								
NRC RG 1.111	1	Jul-77										X	X																								
NRC RG 1.112	0	Apr-76											X																								
NRC RG 1.113	1	Apr-77																								X											
NRC RG 1.125	1	Oct-78																X	X		X		X														
NRC RG 1.132	2	Oct-03																									X	X	X	X	X						
NRC RG 1.138	2	Dec-03																												X	X						
NRC RG 1.145	1	Nov-82										X																								X	
NRC RG 1.165	0	Mar-97																									X	C	X								
NRC RG 1.183	0	Jul-00										X																								X	
NRC RG 1.198	0	Nov-03																										X		X	X						
NRC RG 4.2 and Supplement 1	2 S-1	Jul-76 Sep-00									X																										
NRC RG 4.4	0	May-74																						X		X											
NRC RG 4.7	2	Apr-98				X						X															X	X	X	X					X		
NUREG-0800 / RS-002																																					
RS-002, Main Body Document, Section 4.4			X																																		
RS-002, Attachment 2, Section 2.1.1				X																																	
RS-002, Attachment 2, Section 2.1.2					X																																
RS-002, Attachment 2, Section 2.1.3						X																															
RS-002, Attachment 2, Section 2.2.1 - 2.2.2							X																														
RS-002, Attachment 2, Section 2.2.3								X																													

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Table 1-2 (cont.) Regulatory Compliance Matrix

Legend:
X = Complies
C = Clarification Required, See Table 1-3

Regulatory Requirements Document Title	Rev.	Date	Chapter 1	2.1.1	2.1.2	2.1.3	2.2.1 - 2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5	2.4.6	2.4.7	2.4.8	2.4.9	2.4.10	2.4.11	2.4.12	2.4.13	2.5.1	2.5.2	2.5.3	2.5.4	2.5.5	2.5.6	3.5.1.6	13.3	13.6	Chapter 15	Chapter 17
RS-002, Attachment 2, Section 2.3.1									X																												
RS-002, Attachment 2, Section 2.3.2										X																											
RS-002, Attachment 2, Section 2.3.3											X																										
RS-002, Attachment 2, Section 2.3.4												X																									
RS-002, Attachment 2, Section 2.3.5													X																								
RS-002, Attachment 2, Section 2.4.1														X																							
RS-002, Attachment 2, Section 2.4.2															X																						
RS-002, Attachment 2, Section 2.4.3																X																					
RS-002, Attachment 2, Section 2.4.4																	X																				
RS-002, Attachment 2, Section 2.4.5																		X																			
RS-002, Attachment 2, Section 2.4.6																			X																		
RS-002, Attachment 2, Section 2.4.7																				X																	
NUREG-0800, Section 2.4.8	2	Jul-81																			X																
RS-002, Attachment 2, Section 2.4.9																						X															
NUREG-0800, Section 2.4.10	2	Jul-81																					X														
RS-002, Attachment 2, Section 2.4.11																								X													
RS-002, Attachment 2, Section 2.4.12																									X												
RS-002, Attachment 2, Section 2.4.13																										X											
NUREG-0800, Section 2.5.1	3	Mar-97																									X										
NUREG-0800, Section 2.5.2	3	Mar-97																										X									
NUREG-0800, Section 2.5.3	3	Mar-97																											X								
RS-002, Attachment 2, Section 2.5.4																														X							
NUREG-0800, Section 3.7.2	Dr-3	Apr-96																												X							
RS-002, Attachment 2, Section 2.5.5																															X						
RS-002, Attachment 2, Section 3.5.1.6																																	X				
NUREG-0800, Section 3.5.1.6	2	Jul-81																															X				
RS-002, Attachment 2, Section 13.3.1																																		X			
RS-002, Attachment 2, Note 2																																			X		
RS-002, Attachment 2, Section 15.0																																				X	
NUREG-0800, Chapter 15	1&2	Jul-81																																		X	
RS-002, Attachment 2, Section 17.1.1																																					X

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Table 1-3 Regulatory Compliance Clarifications

Regulatory Document	Affected ESP Application Section	Clarification
Reg Guide 1.60	2.5.2	Site-specific response spectra is derived in accordance with 10 CFR Part 100 Subpart B 100.23. The standard spectral shape of Regulatory Guide is not used.
Reg Guide 1.165	2.5.2	Regulatory Guide 1.165 is used to (1) conduct geological, seismological, and geophysical investigations of the site and region around the site, (2) identify and characterize seismic sources, and (3) perform PSHA. The procedure to determine the SSE for the site departs from the Regulatory Guide 1.165 procedure. Site-specific SSE spectra following the procedures of ASCE 43-05 for defining the Design Response Spectra (DRS) using a Target Performance Goal (P_f) of a mean annual probability of exceedance of 1E- 05 is used to define the ESP SSE design ground motion.
Reg Guide 1.70	13.6	Regulatory Guide 1.70 requires the security plan to be submitted as a separate document. The security plan will be submitted with the COL. The ESP application follows the guidance described in RS-002, Attachment 2, Note 2.

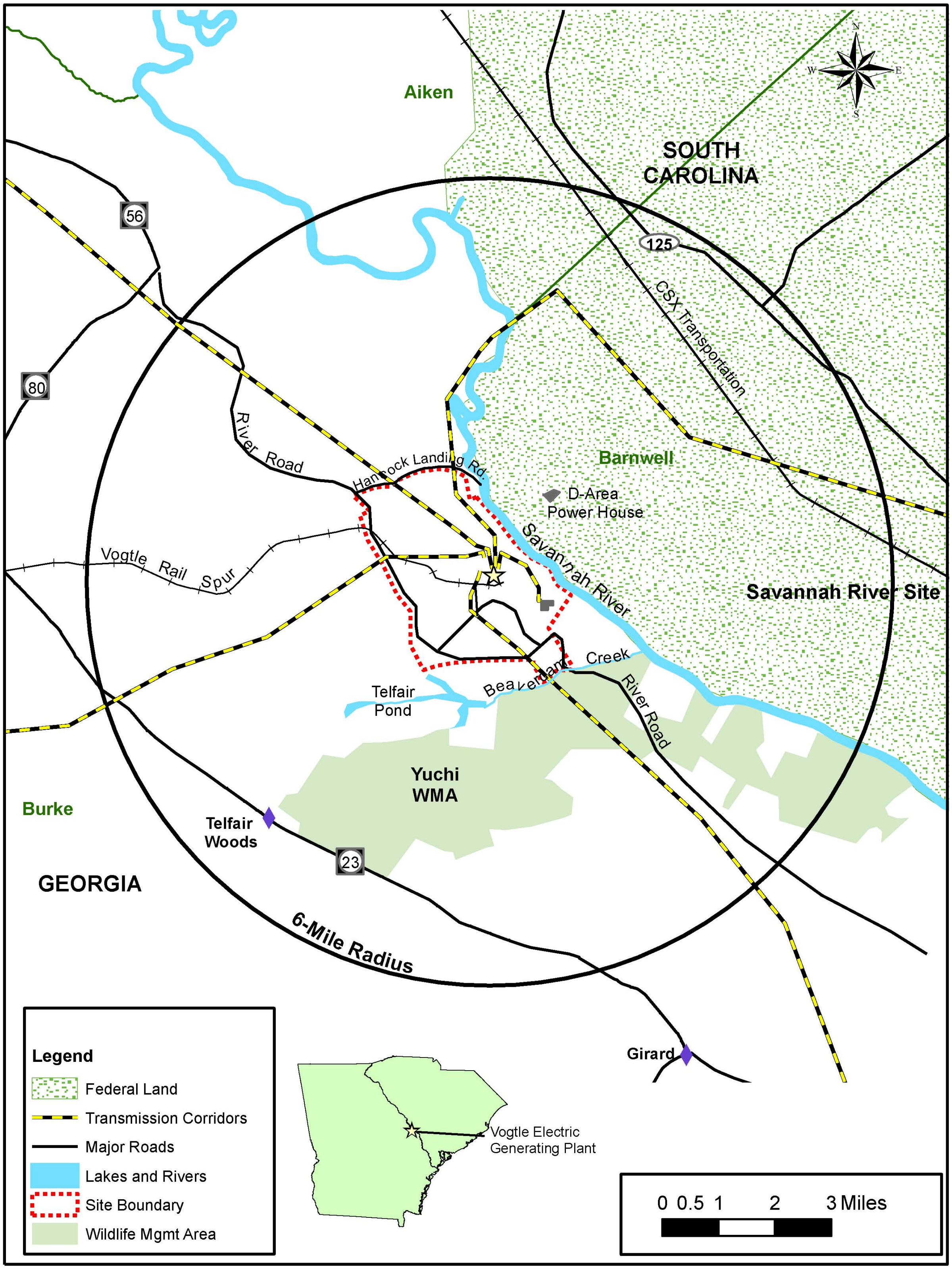

Figure 1-1 6-Mile Vicinity

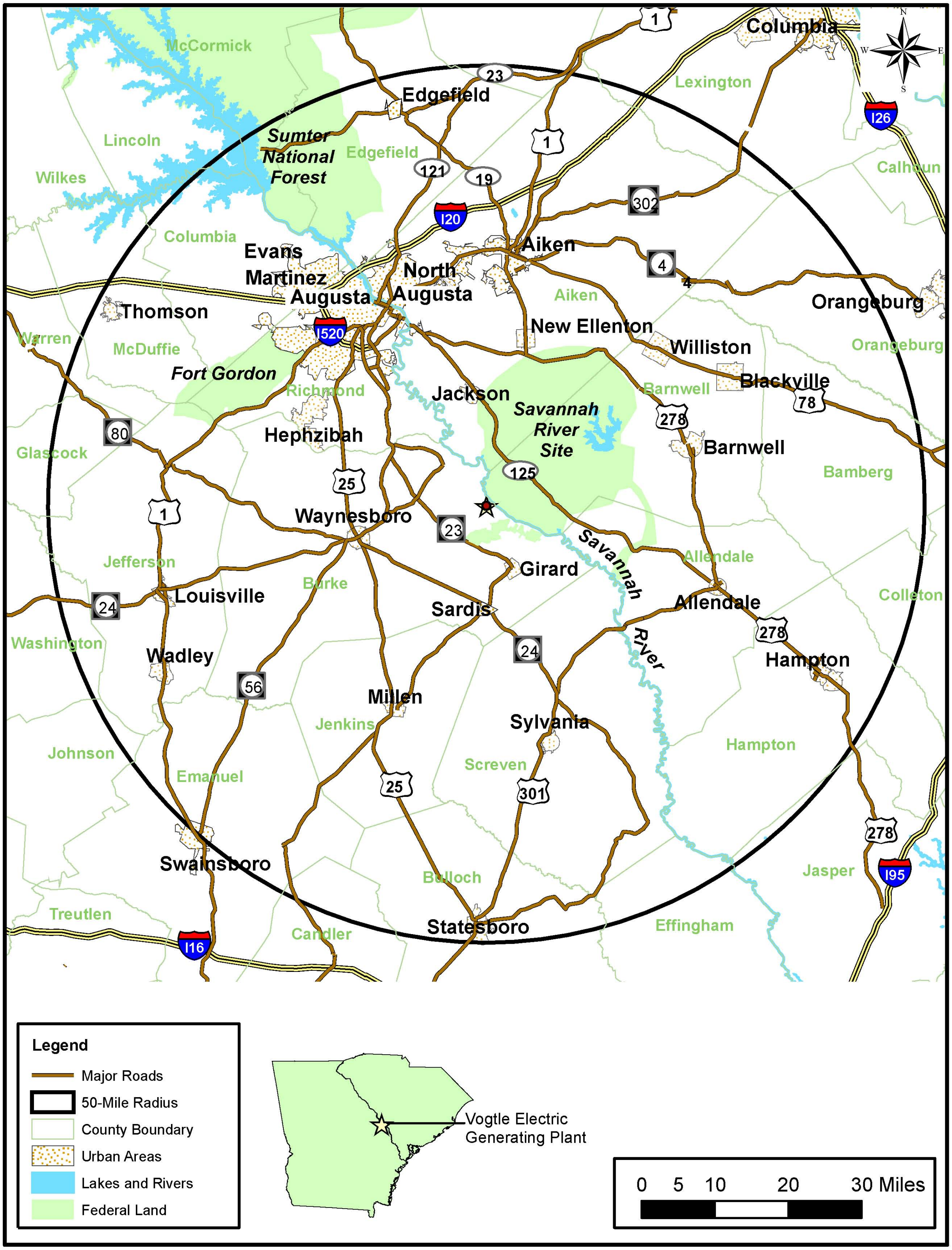

Figure 1-2 50-Mile Vicinity

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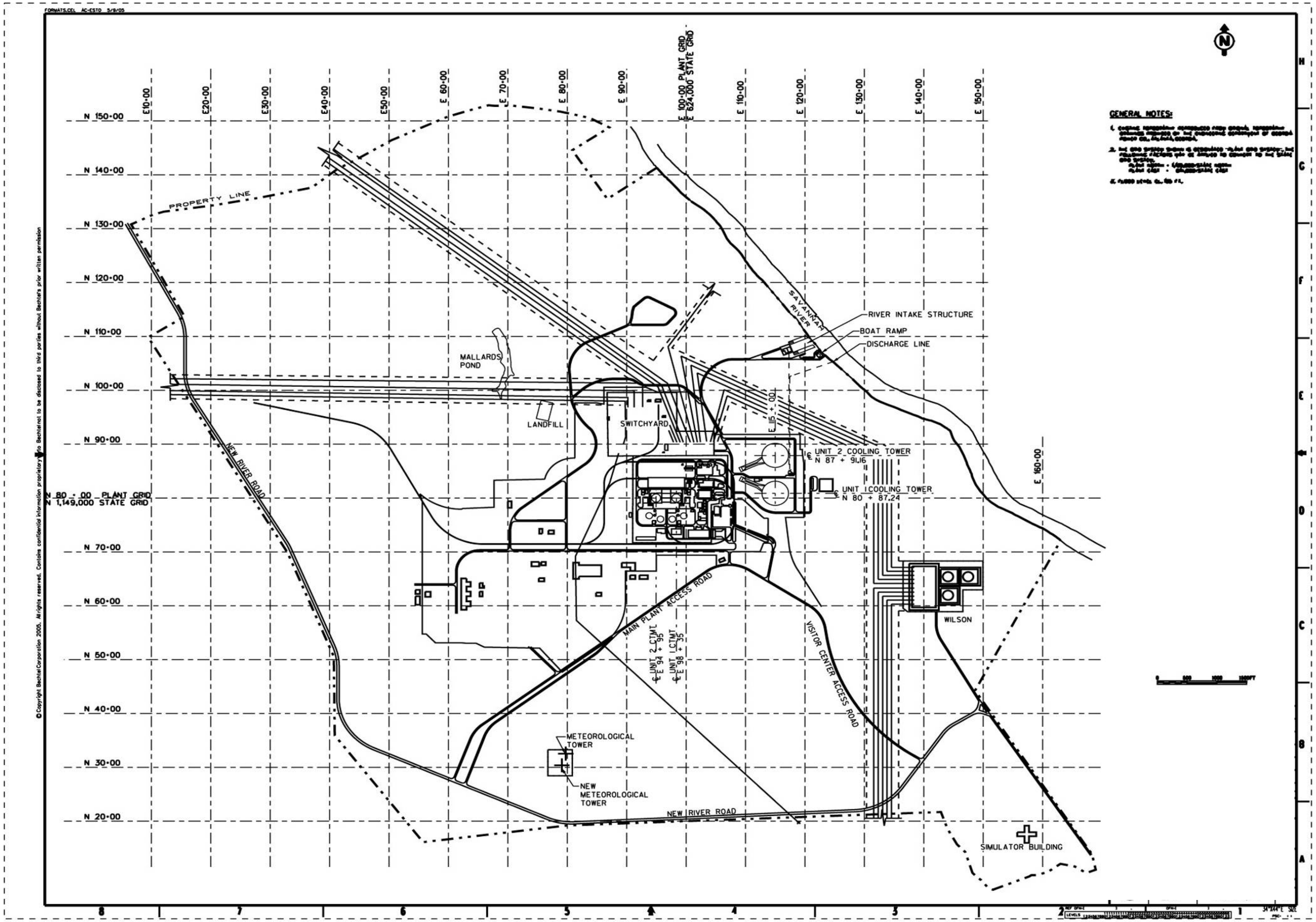

Figure 1-3 Site Layout – Current Development

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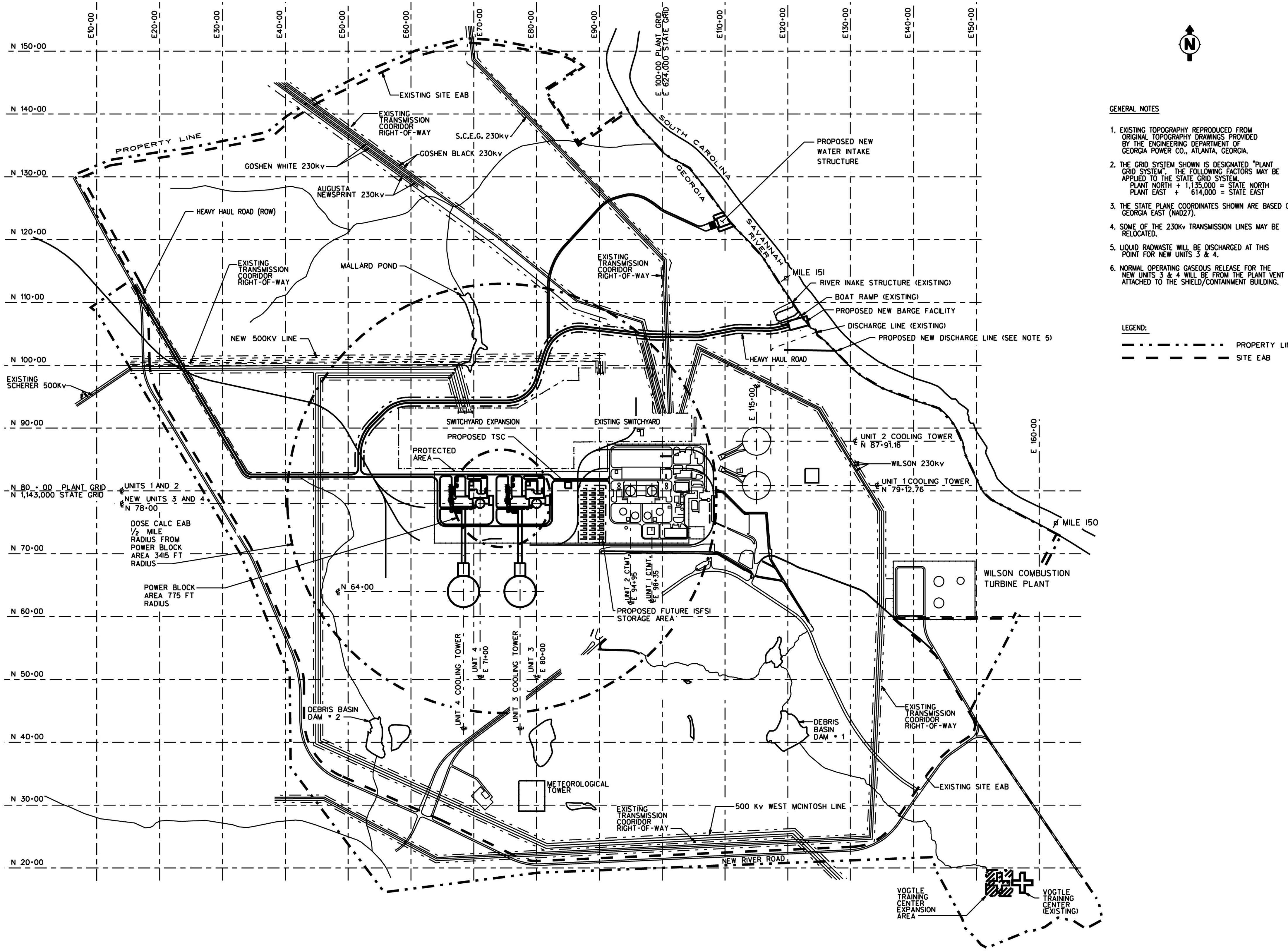

Figure 1-4 Site Layout – New Development

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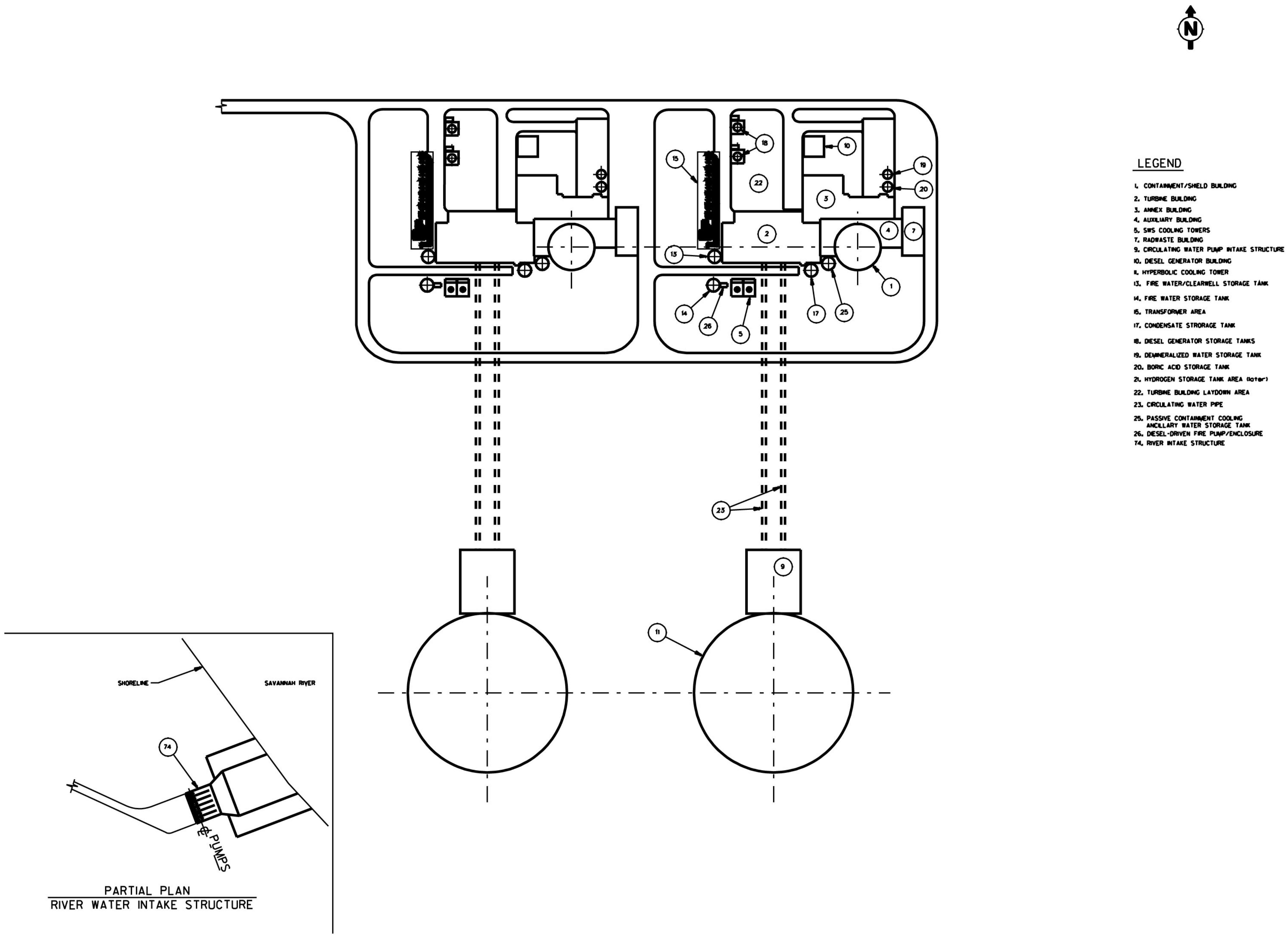

Figure 1-5 VEGP Units 3 and 4 Power Block Arrangement

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Chapter 1 References

(NRC-NEI 2004) *Early Site Permit Template*, NRC letter to NEI, J.E. Lyons to A. Heymer, June 22, 2004.

(Westinghouse 2005) *AP1000 Design Control Document,* AP1000 Document No. APP-GW-GL-700, Revision 15, Westinghouse Electric Company, 2005.

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Chapter 2 Site Characteristics

Chapter 2 describes the characteristics of the Vogtle Electric Generating Plant (VEGP) site. The site location and description are provided in sufficient detail to support a safety assessment. The chapter is divided into five sections:

- Geography and demography (Section 2.1)
- Nearby industrial, transportation, and military facilities (Section 2.2)
- Meteorology (Section 2.3)
- Hydrology (Section 2.4)
- Geology and seismology (Section 2.5)

2.1 Geography and Demography

2.1.1 Site Location and Description

2.1.1.1 Site Location

The proposed Units 3 and 4 will be built on the existing VEGP site. The 3,169-acre VEGP site is located on a coastal plain bluff on the southwest side of the Savannah River in eastern Burke County. The site exclusion area boundary (EAB) is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River (River Miles 150.0 to 151.7). The property boundary entirely encompasses the EAB and extends beyond River Road in some areas. The site is approximately 30 river miles above the US 301 bridge and directly across the river from the Department of Energy's (DOE's) Savannah River Site (SRS) (Barnwell County, South Carolina). The VEGP site is approximately 15 mi east-northeast of Waynesboro, Georgia, and 26 mi southeast of Augusta, Georgia, the nearest population center (i.e., having more than 25,000 residents). It is also about 100 mi from Savannah, Georgia, and 150 river miles from the mouth of the Savannah River.

The VEGP site is situated within three major resource areas: the Southern Piedmont, the Carolina and Georgia Sand Hills, and the Coastal Plain. These characteristics are typical of land forms that resulted from historical marine sediment deposits in central and eastern Georgia. There are no mountains in the general area.

Burke County includes five incorporated towns: Waynesboro, Girard, Keysville, Midville, and Sardis. Of these five towns, only the town of Girard is within 10 mi of the VEGP site. According to the 2000 Census survey, Girard, which has a population of 227, is the largest community within 10 mi of the VEGP site **(USCB 2000b)**. Figure 2.1-1 shows Girard and its location with respect to the VEGP site Access to the site is by River Road via US Route 25, Georgia Routes 56, 80, 24, and 23. A railroad spur connects the site to the Norfolk Southern Savannah-to-Augusta track.

Figure 2.1-2 shows highways, railways and airports located in the 50 mi surrounding area. The nearest highway, Interstate 20 (I-20), passing through Augusta and connecting Columbia, South Carolina, with Atlanta, Georgia, is located approximately 29 mi north of the VEGP site.

2.1.1.2 Site Description

VEGP Units 3 and 4 (Westinghouse Electric Company, LLC [Westinghouse] AP1000 certified reactor design plants) will be located in the power block area shown in Figure 1-4. The centerline of the proposed VEGP Unit 3 will be located approximately 1,500 ft west and 200 ft south of the center of the existing VEGP Unit 2 containment building. The proposed VEGP Unit 4 will be approximately 900 ft west of proposed VEGP Unit 3. The coordinates of the center of the containment building for VEGP Units 3 and 4 are as follows:

Unit	Georgia East Coordinates (NAD27) 1001 – Georgia East (ft)		UTM Coordinates (NAD83) Zone 17 – 84W to 78W (ft)	
3	N	1,142,800	N	12,031,560.550
	E	622,000	E	1,405,433.646
4	N	1,142,800	N	12,031,570.558
	E	621,100	E	1,404,533.934

No commercial, industrial, institutional, recreational, or residential structures are located within the site area, with the exception of Plant Wilson, the Georgia Power Company (GPC) combustion turbine plant. The nearest point to the exclusion area boundary (EAB) is located approximately 3,400 ft southwest of the proposed VEGP Units 3 and 4 power block area.

2.1.1.3 Boundary for Establishing Effluent Release Limits

VEGP Units 3 and 4 will be located within the power block area, which is the perimeter of a 775-ft-radius circle with the centroid at a point between the two AP1000 units. The EAB as described previously, will be the same as the exclusion area boundary for the existing VEGP units. There are no residents in this exclusion area. No unrestricted areas within the site boundary are accessible to members of the public. Access within the property boundary is controlled as discussed in Section 2.1.2. Detailed discussion of effluent release points is provided in Section 2.3.5.

All areas outside the exclusion area will be unrestricted areas in the context of 10 CFR 20. Additionally, the guidelines provided in 10 CFR 50, Appendix I, for radiation exposures to meet the criterion “as low as is reasonably achievable” would be applied at the EAB.

2.1.2 Exclusion Area Authority and Control

The EAB is bounded by River Road, Hancock Landing Road, and 1.7 miles of the Savannah River (River Miles 150.0 to 151.7) as shown in Figure 1-4.

2.1.2.1 Authority

Ownership general information required by 10 CFR 50.33 is described in Part 1, Chapter 3 of the ESP application. The co-owners own the entire plant exclusion area in fee simple including mineral rights. Pursuant to the VEGP owner's agreement, GPC, for itself and as agent for the co-owners, has delegated to Southern Nuclear Operating Company, Inc. (SNC) complete authority to regulate any and all access and activity within the entire plant exclusion area.

The perimeter of the VEGP EAB is adequately posted with "No Trespassing" signs on land and with signs along the Savannah River, and indicate the actions to be taken in the event of emergency conditions at the plant.

2.1.2.2 Control of Activities Unrelated to Plant Operation

There are only two facilities within the EAB that have authorized activities unrelated to nuclear plant operations, the visitor's center and the GPC combustion turbine plant, Plant Wilson.

The exclusion area outside the controlled area fence will be posted and will be closed to persons who have not received permission to enter the property.

The access route to the visitor's center is from River Road along the main plant access road to the road leading to the visitor's center. Access to the visitor's center is controlled by security at the pavilion (access control point) on the plant entrance road. Normally, only a few administrative personnel are located at the visitor's center. Because of the remote location of the site, the number of visitors at the center is minimal. However, approved persons visiting the center will occupy the center and the area and parking lot immediately adjacent to the center. In the event of emergency conditions at the plant, the emergency plan provides for notification of visitors to the center concerning the proper actions to be taken and evacuation instructions.

Plant Wilson is controlled and operated by VEGP staff. Access to the facility from New River Road is limited by locked gates. The emergency plan also provides for notification and evacuation of VEGP personnel at Plant Wilson.

SNC normally will not control passage or use of the Savannah River along the exclusion area boundary. "No trespassing" signs are posted near the river indicating the actions to be taken in the event of emergency conditions at the plant.

2.1.2.3 Arrangements for Traffic Control

No state or county roads, railways, or waterways traverse the VEGP exclusion area.

SNC has made arrangements with the Burke County Sheriff for control of traffic nearby in the event of an emergency.

2.1.3 Population Distribution

The population distribution surrounding the VEGP site, up to a 50-mi (80 km) radius, was estimated based on the year 2000 US Census Bureau decennial census data **(NRC 2003)**. The population distribution is estimated in 10 concentric bands at 0 to 1 mi, 1 to 2 mi, 2 to 3 mi, 3 to 4 mi, 4 to 5 mi, 5 to 10 mi, 10 to 20 mi, 20 to 30 mi, 30 to 40 mi, and 40 to 50 mi from the center of the power block area (generating facilities and switchyard), shown in Figure 1-4 and 16 directional sectors, each direction consisting of 22.5 degrees. The population projections for 2010, 2020, 2030, 2040, and 2070 have been estimated by calculating an annualized growth rate using the 1980 and 2000 census data (by county) as the base **(USCB 1990a, 2000a)**.

2.1.3.1 Resident Population Within 10 Mi

Figure 2.1-1 shows the general locations of the municipalities and other features within 10 mi (16 km) of the VEGP site. According to the 2000 Census, Girard, with a population of 227, is the largest community within 10 mi of the site (USCB 2000b). The population of Girard showed an increase of 16.4 percent in the last decade from a population of 195 in 1990 to a population of 227 in 2000 **(USCB 1990b)**.

The population distribution within 10 mi of the site was computed by overlaying the 2000 Census block points data (the smallest unit of census data) on the grid shown in Figure 2.1-1 and summing the population of the census block points within each sector. SNC used SECPOP 2000, a code developed for the NRC by Sandia National Laboratories, to calculate population by emergency planning zone sectors **(NRC 2003)**. SECPOP uses 2000 block data from the US Census Bureau and overlays it into the sectors in the annuli prescribed by the user. The 1980 and 2000 population distributions for each county considered in Georgia and South Carolina were obtained from the U.S Census Bureau and used to calculate a growth rate over 20 years **(USCB 1990a, 2000a)**. Each county growth rate was annualized and used to project future populations within each sector, taking into account the percentage of each sector that each county occupied.

The population distributions and related information were collected and the results tabulated for all distances of interest in all 16 directions. All the north-northeast to east sectors in South Carolina are occupied by the SRS, which has no residents. SRS transients are accounted for in the SRS Emergency Plan and, therefore, are not included in the VEGP Emergency Plan. The SRS will remain a government-controlled facility in perpetuity. The SECPOP 2000 results show that in 2000, the combined resident and transient populations within 5 mi and 10 mi of the VEGP site were 687 and 3,560 persons, respectively. The 10-mi resident and transient population for 2000 is shown in Figure 2.1-3. The resident and transient 10-mi population projections for 2010 through 2070 are shown in Figures 2.1-4 through 2.1-8, with the total population projections listed in the table below.

Year	2010	2020	2030	2040	2070
Population	3,822	4,108	4,406	4,737	5,877

2.1.3.2 Resident Population Between 10 and 50 Mi

The 50-mi (80-km) radius centered at the VEGP site includes all, or parts of, 16 counties in Georgia, and 12 counties in South Carolina (Figure 2.1-10). Augusta, Georgia, approximately 26 mi northwest of the VEGP site, had a population of 195,182 in year 2000. Estimates of the year 2000 resident population between 10 and 50 mi from the VEGP site were computed using the same methodology used to develop the 10-mi population distribution.

The population grid to 50 mi is shown in Figure 2.1-9, and the 50-mi population projections for 2010 through 2070 are shown in Figures 2.1-10 through Figure 2.1-15, with the total population projections listed in the table below.

Year	2010	2020	2030	2040	2070
Population	770,243	893,950	1,056,017	1,272,093	2,530,357

2.1.3.3 Transient Population

2.1.3.3.1 Transient Population Within 10 Miles

Information concerning transient population for the 10-mi radius was obtained from the VEGP Emergency Plan. The transient population includes hunters and fishermen at recreational areas along the Savannah River. Up to 200 hunters and fishermen may be located along the Savannah River on any weekend day during the hunting season **(SNC 2004)**. Although most hunters and fishermen likely reside in the area, this information is not definitive. Therefore, all hunters and fishermen were included as transient population. The construction workforce for VEGP Units 3 and 4 and the existing staff at VEGP were not included as transient population within 10 mi of the plant because they are counted as residents within the 10–50 mi radius area.

Portions of the SRS fall within 10 mi of the VEGP site. However, SRS workers are not counted as transient population in the VEGP Emergency Plan because SRS is responsible for its own evacuation plan. **(SNC 2004)**

2.1.3.3.2 Transient Population Between 10 and 50 Miles

Colleges, schools, hospitals, a military base, and the SRS are between 10 and 50 mi from the VEGP site. In addition, thousands of people visit Augusta and the surrounding area out to the 50-mi limit annually during the week of the Masters Tournament and for other annual events within a 50-mi radius. However, compared to the resident population within a 50-mi radius, the transient population is expected to be very small.

2.1.3.4 Low Population Zone

The low population zone (LPZ) for VEGP Units 3 and 4 is the same as the LPZ for the existing VEGP units and consists of the area falling within a 2-mi radius of the midpoint between the VEGP Unit 1 and Unit 2 containment buildings. The resident and transient population distribution within the LPZ is indicated in Figures 2.1-3 through 2.1-8, based on the 2000 Census and projections through 2070. The LPZ population projections are also shown in the table below.

Year	2000	2010	2020	2030	2040	2070
Population	93	100	109	116	126	157

There are no schools in the LPZ. One private school is located approximately 9 mi west of the site, Lord's House of Praise Christian School, with an enrollment of approximately 50 students. S.G.A. Elementary School is the nearest public school and is located in the town of Sardis approximately 11 mi from the VEGP site **(BCS 2006)**. As stated in the previous section, the only significant transient population within 10 mi is hunters and fishermen along the banks of the Savannah River. Approximately 50 hunters and fishermen could be considered transient population within the LPZ. River Road is the only road within the LPZ. No towns, recreational facilities, hospitals, schools, prisons, or beaches are within the LPZ **(SNC 2004)**. Design basis accidents are evaluated in Chapter 15 to demonstrate that doses at the LPZ will be within the dose limits of 10 CFR 100.21(c) and 10 CFR 50.34(a)(1)(ii).

2.1.3.5 Population Center

The nearest population center to the VEGP site with more than 25,000 residents is the City of Augusta, Georgia, with a 2000 population of 195,182 **(USCB 2000b)**. Augusta is approximately 26 miles north-northwest of the VEGP site.

2.1.3.6 Population Density

Regulatory Position C.4 of Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Plants*, Revision 2, April 1998 (RG 4.7) and NRC Review Standard RS-002, *Processing Applications for Early Site Permits*, May 3, 2004 (RS-002) provide guidance on suitable population densities. Given an approved ESP period of 20 years, a conservative startup date of 2025, and an operational period of 40 years, operations could extend until 2065. Figure 2.1-16 is a plot of population density to radial distance from the plant. Three VEGP site curves, one actual and two projected, were plotted to illustrate that the VEGP site vicinity population density is well below the regulatory guidance for population density. The three VEGP curves show the cumulative population in 2000 within 20 mi of the site and projected cumulative populations in 2040 and 2070. On the same figure, spanning the same radial distances, regulatory guidance population curves are plotted for hypothetical densities of 500 persons per square mile and 1,000 persons per square mile. Based on these projections, population densities, averaged over any radial distance out to 20 mi, are expected to be less than 500 persons per square mile over the lifetime of the new units.

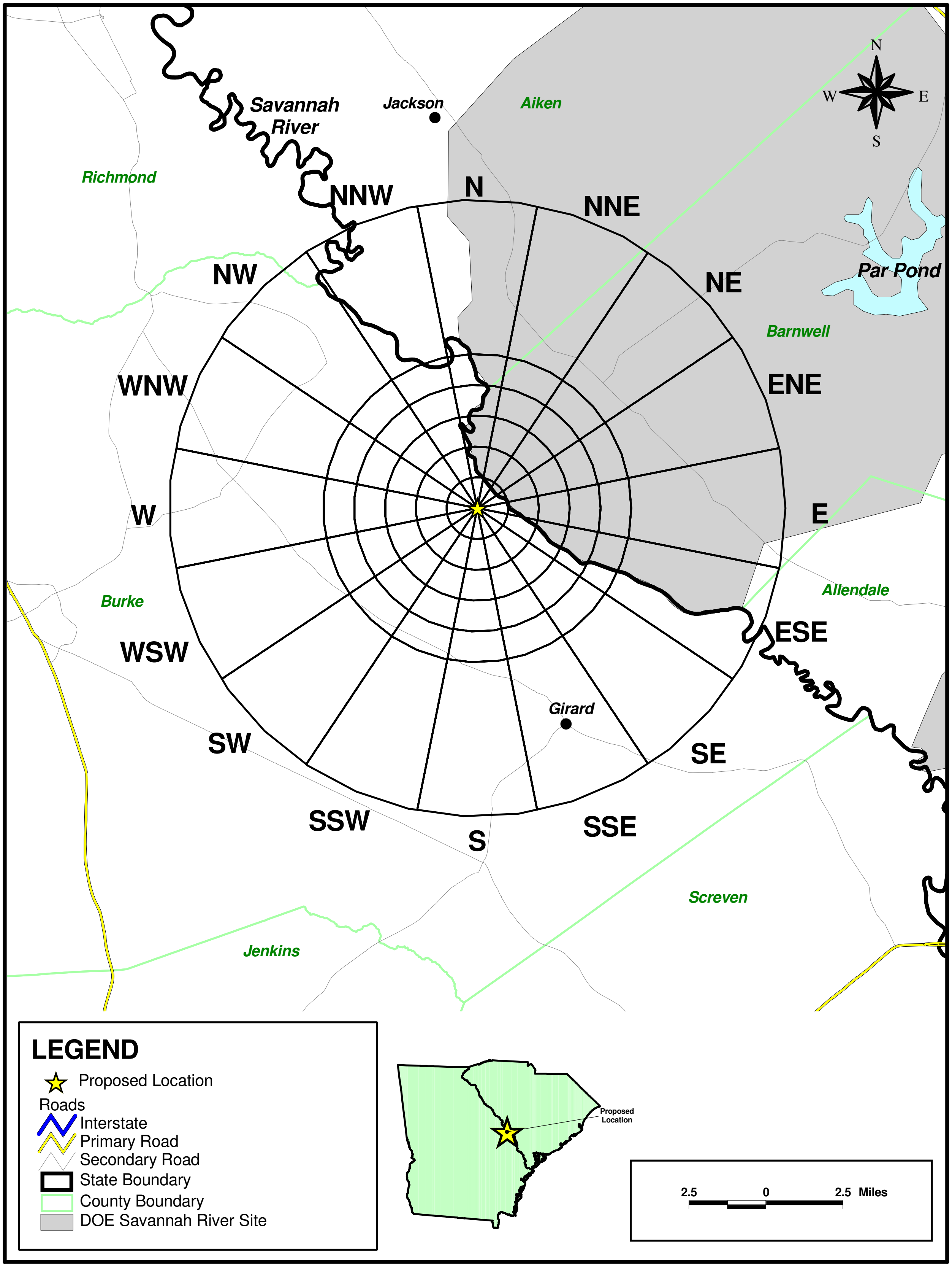

Figure 2.1-1 10-Mile Surrounding Area

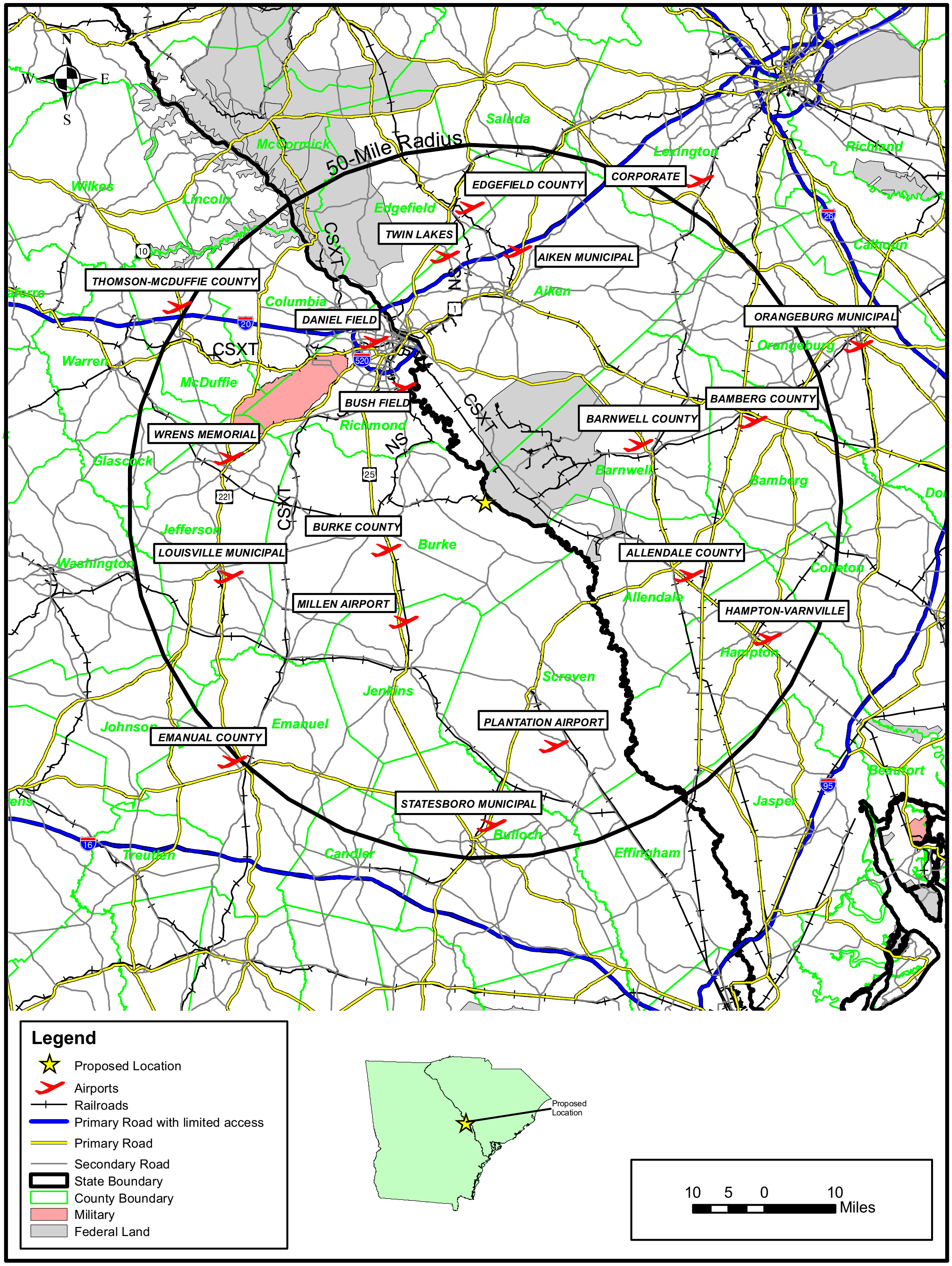

Figure 2.1-2 50-Mile Surrounding Area

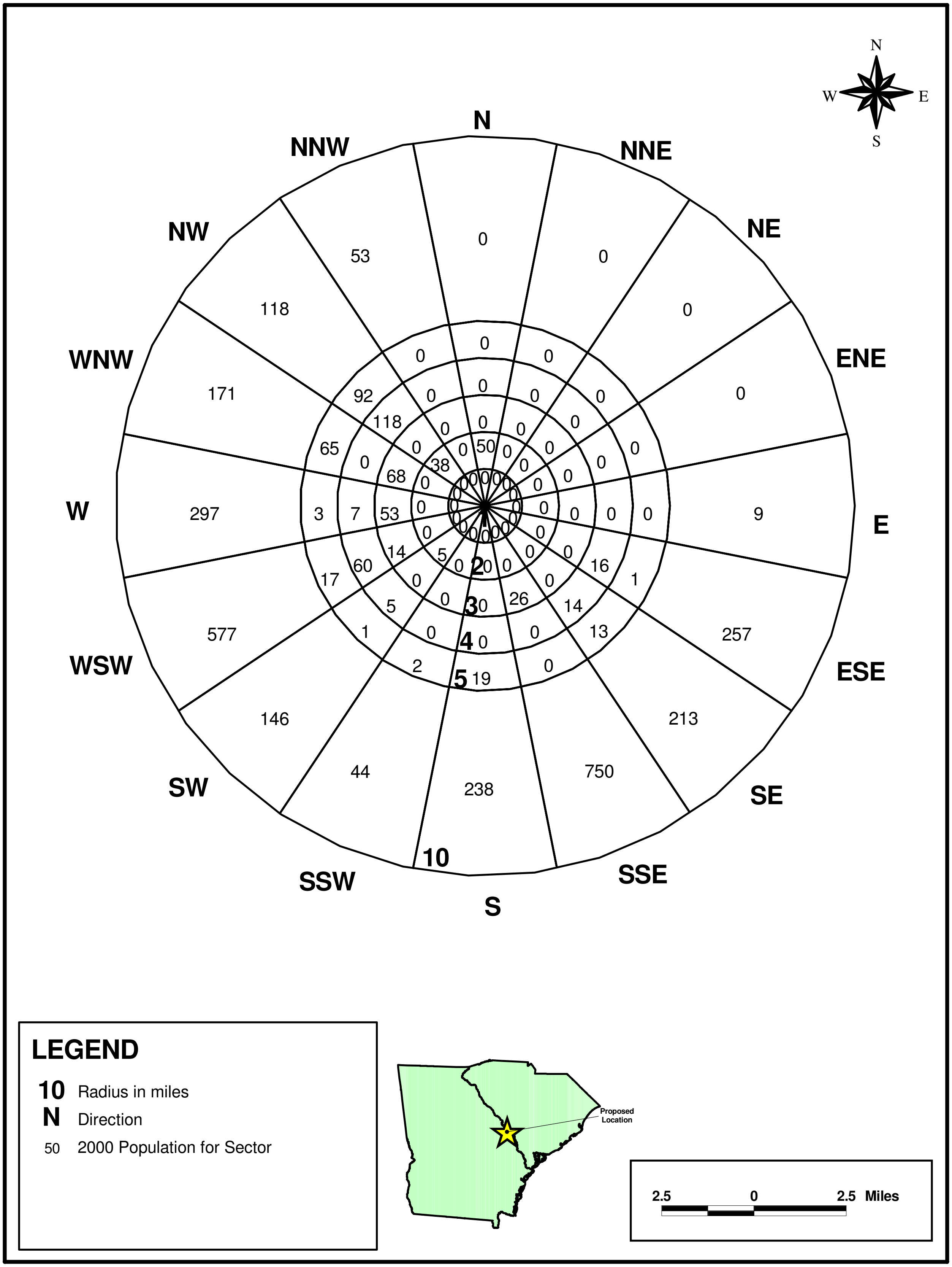

Figure 2.1-3 10-Mile Resident and Transient Population Distribution 2000

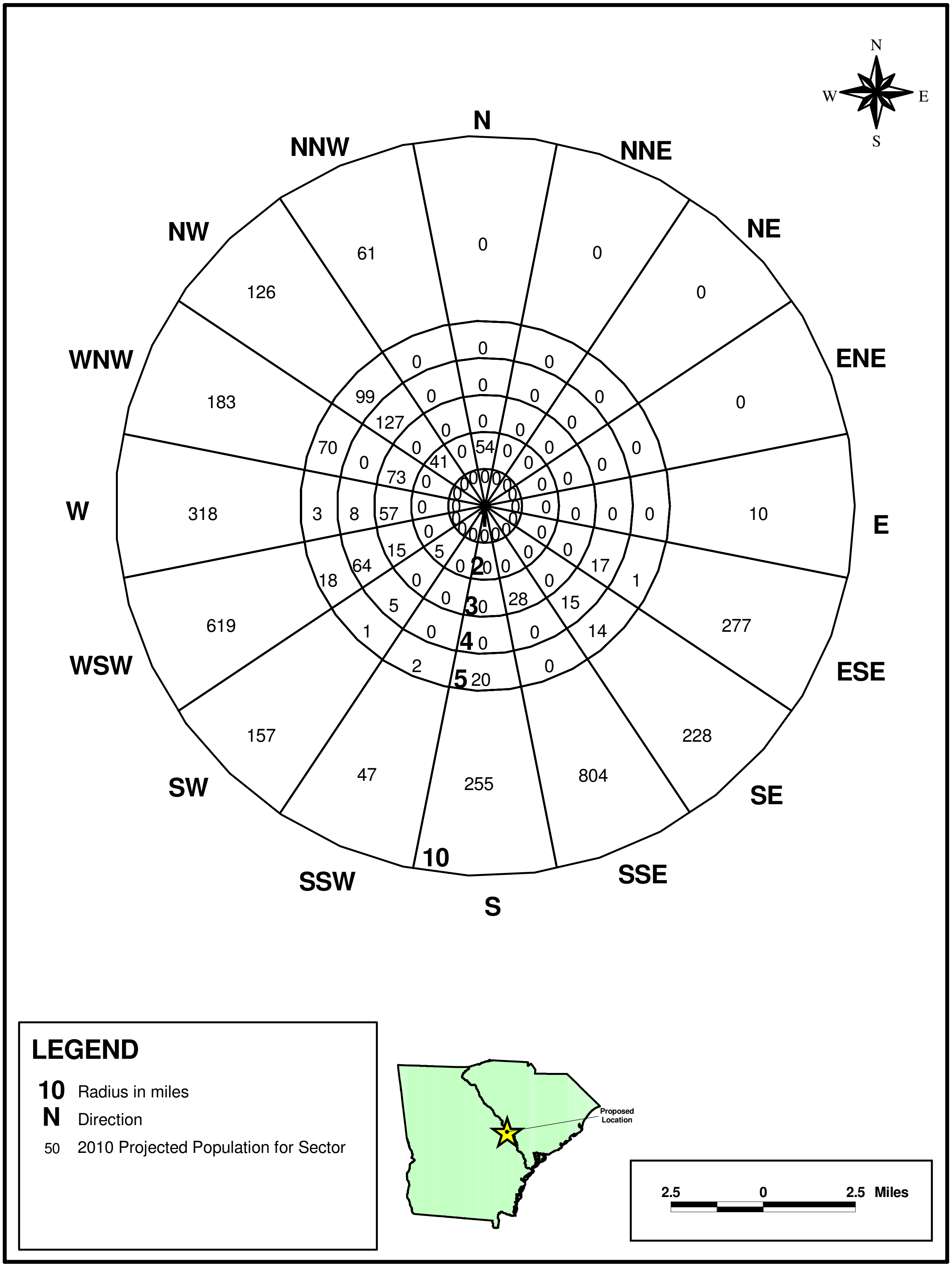

Figure 2.1-4 10-Mile Resident and Transient Population Distribution 2010

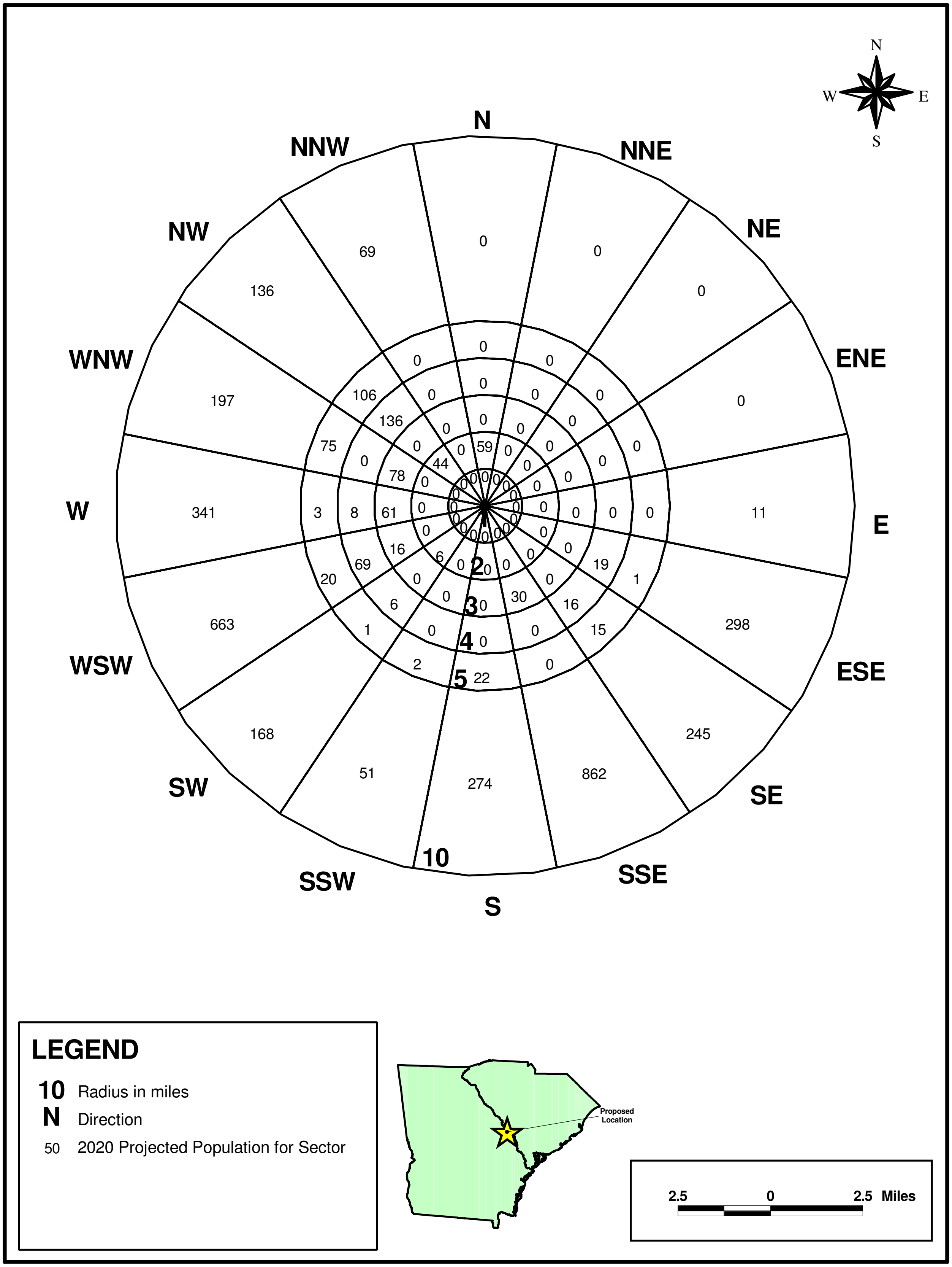

Figure 2.1-5 10-Mile Resident and Transient Population Distribution 2020

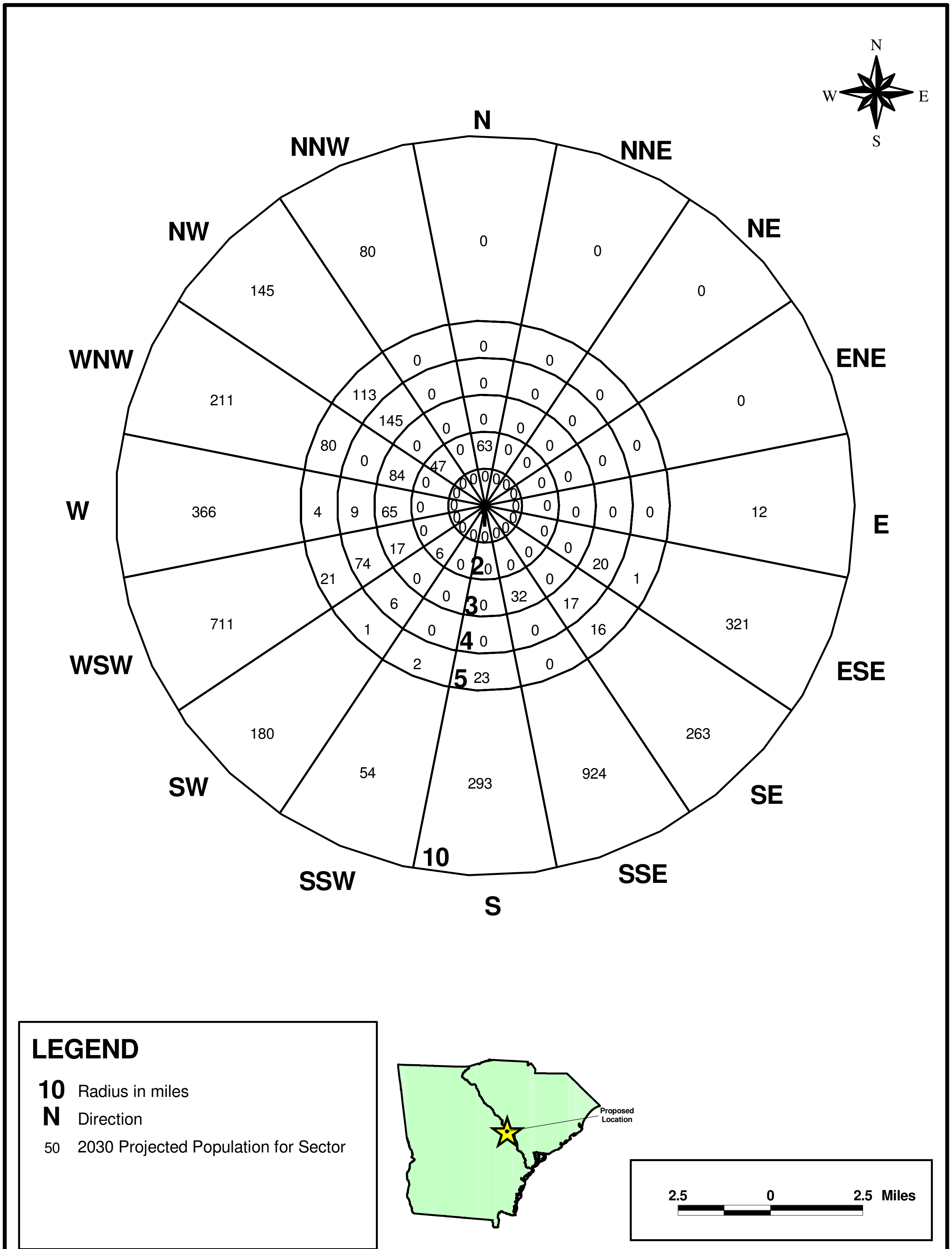

Figure 2.1-6 10-Mile Resident and Transient Population Distribution 2030

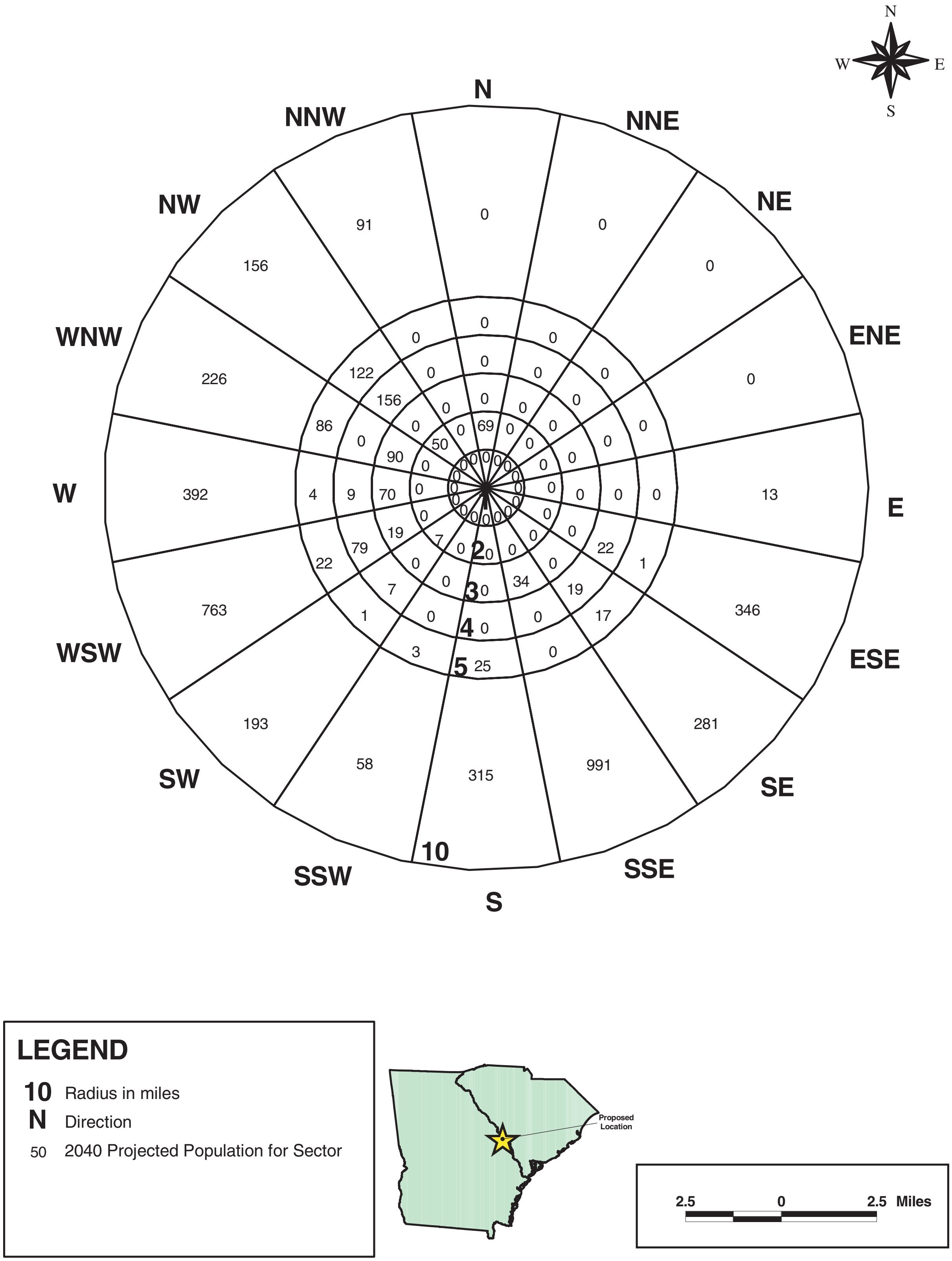

Figure 2.1-7 10-Mile Resident and Transient Population Distrubution 2040

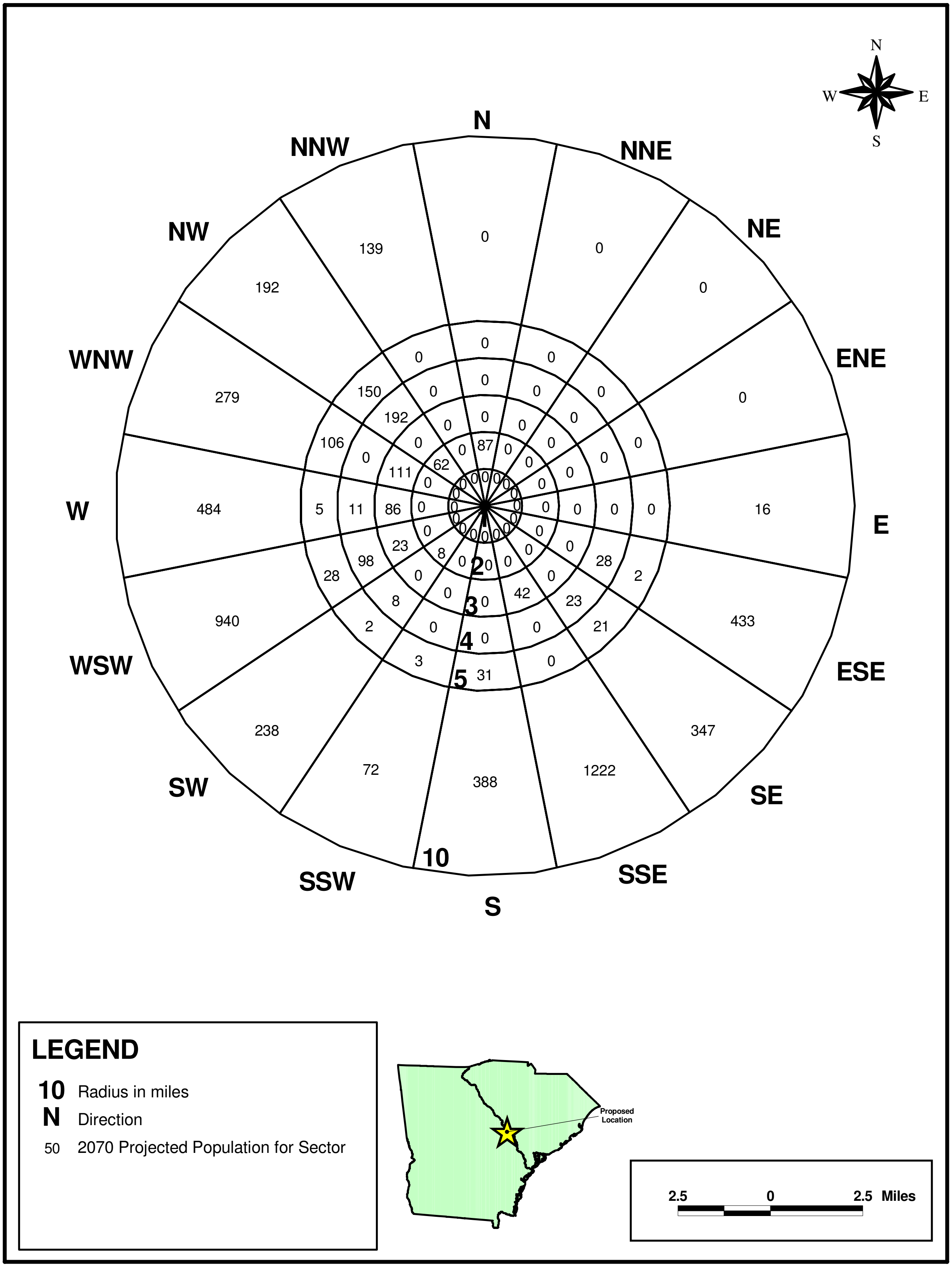

Figure 2.1-8 10-Mile Resident and Transient Population Distribution 2070

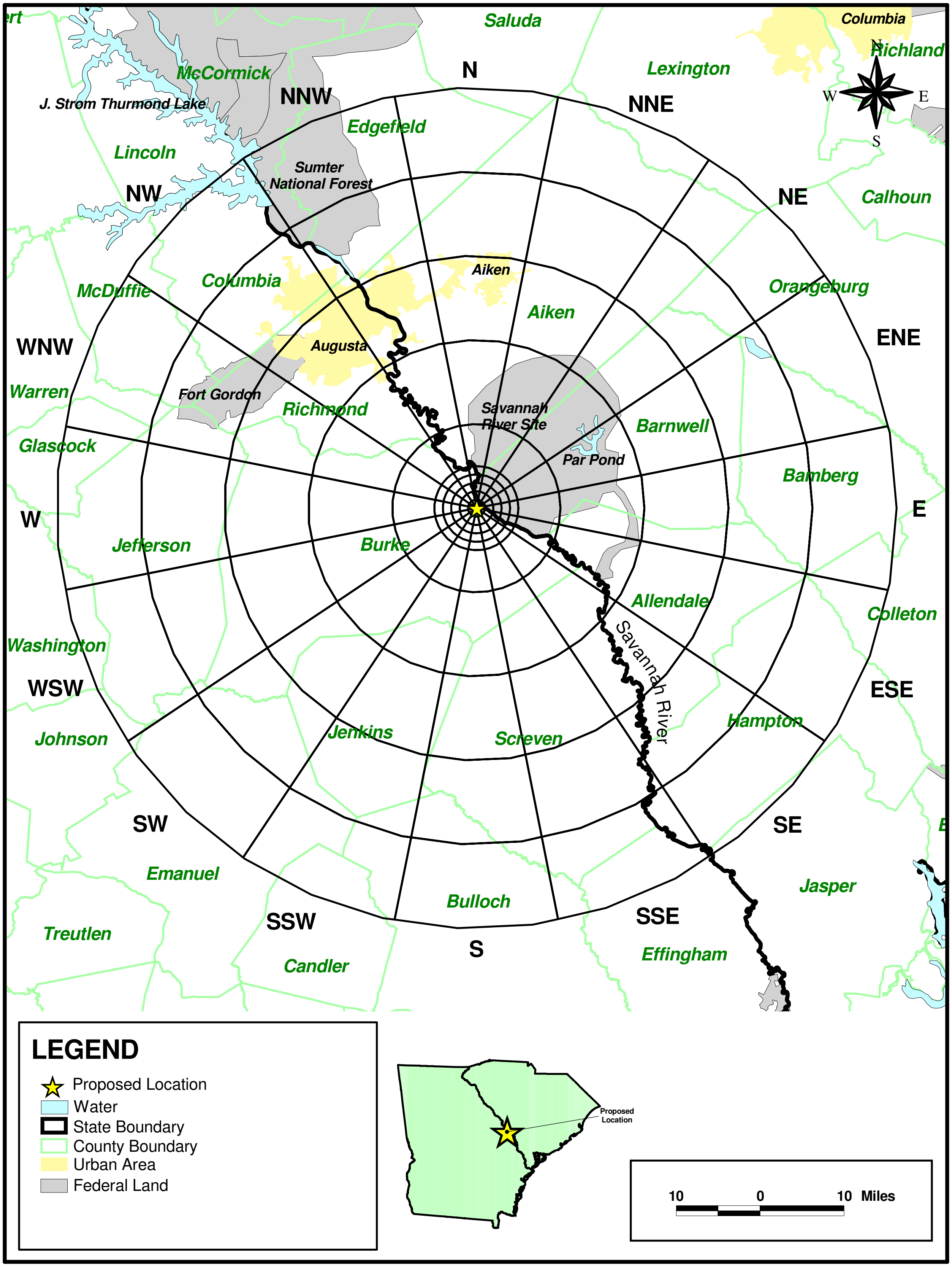

Figure 2.1-9 Population Grid Out to 50 Miles

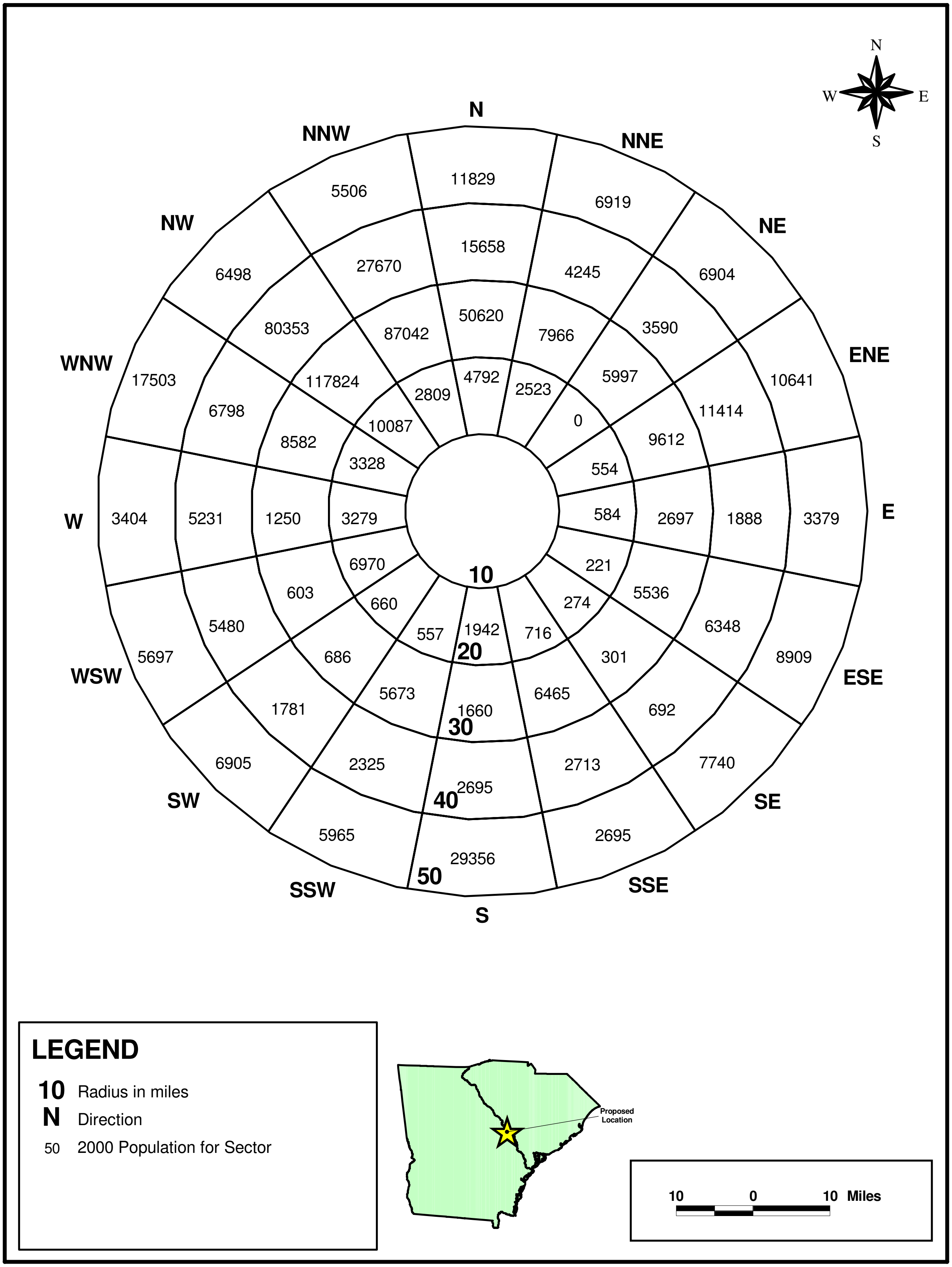

Figure 2.1-10 50-Mile Resident Population Distribution 2000

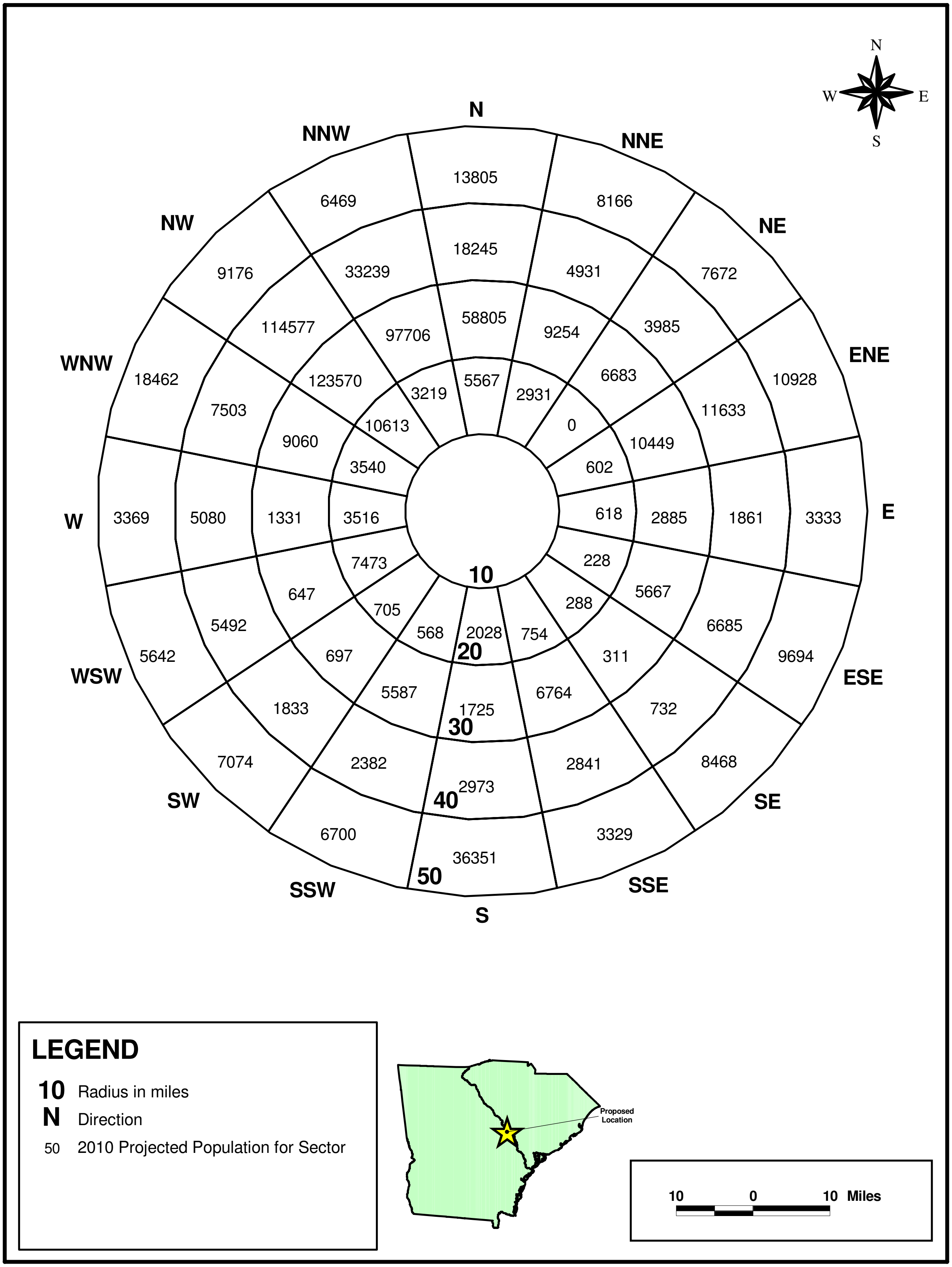

Figure 2.1-11 50-Mile Resident Population Distribution 2010

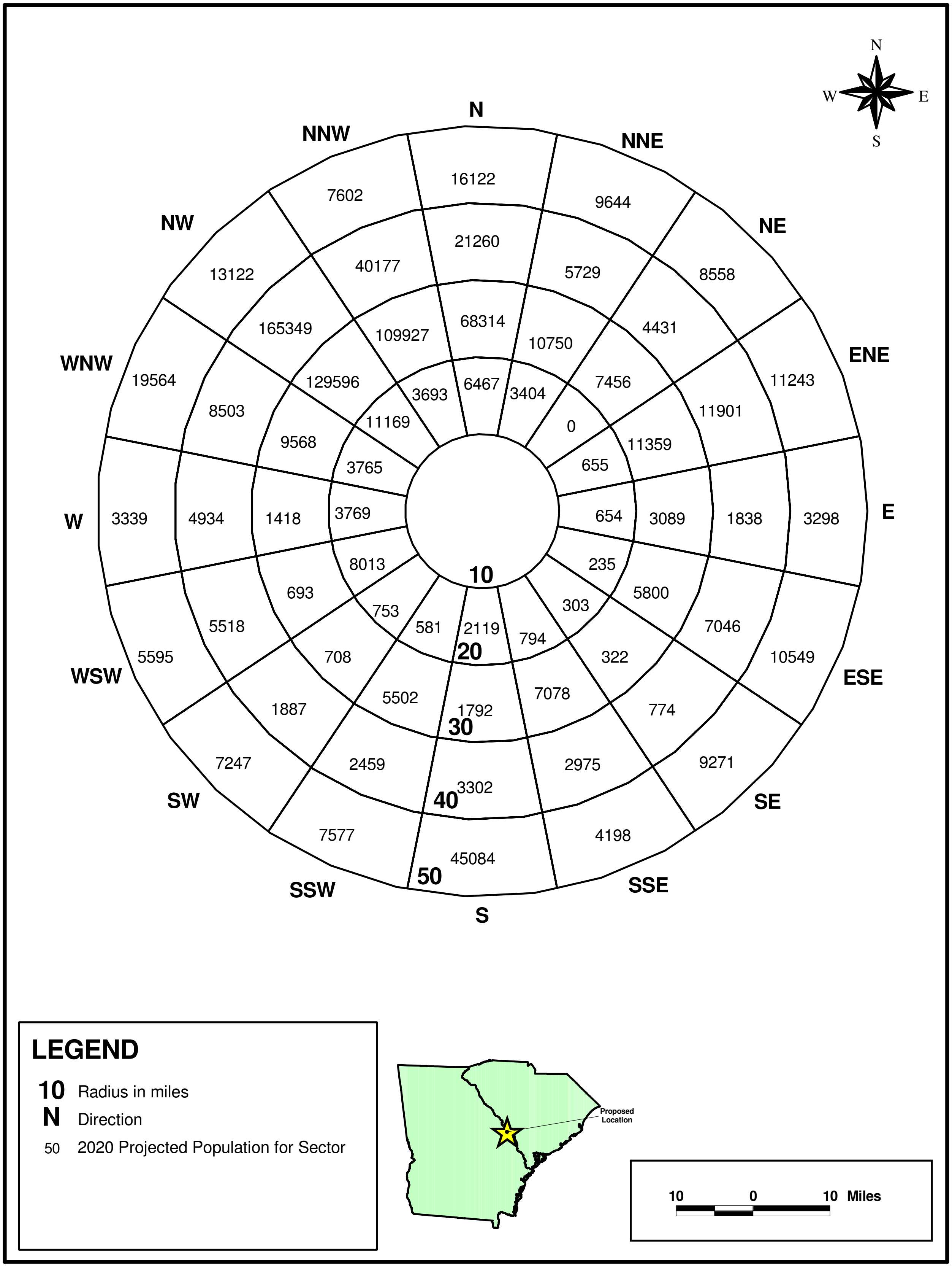

Figure 2.1-12 50-Mile Resident Population Distribution 2020

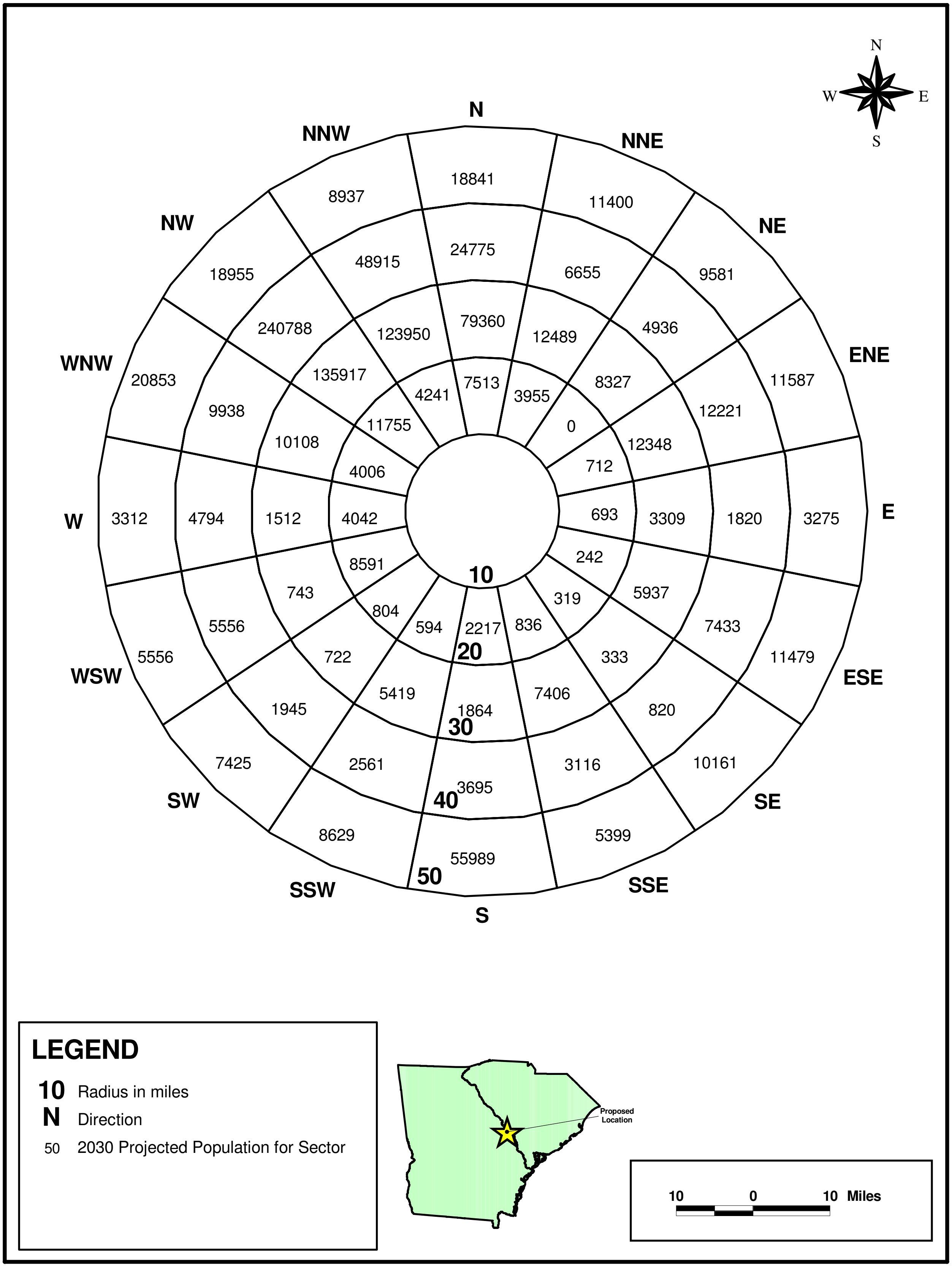

Figure 2.1-13 50-Mile Resident Population Distribution 2030

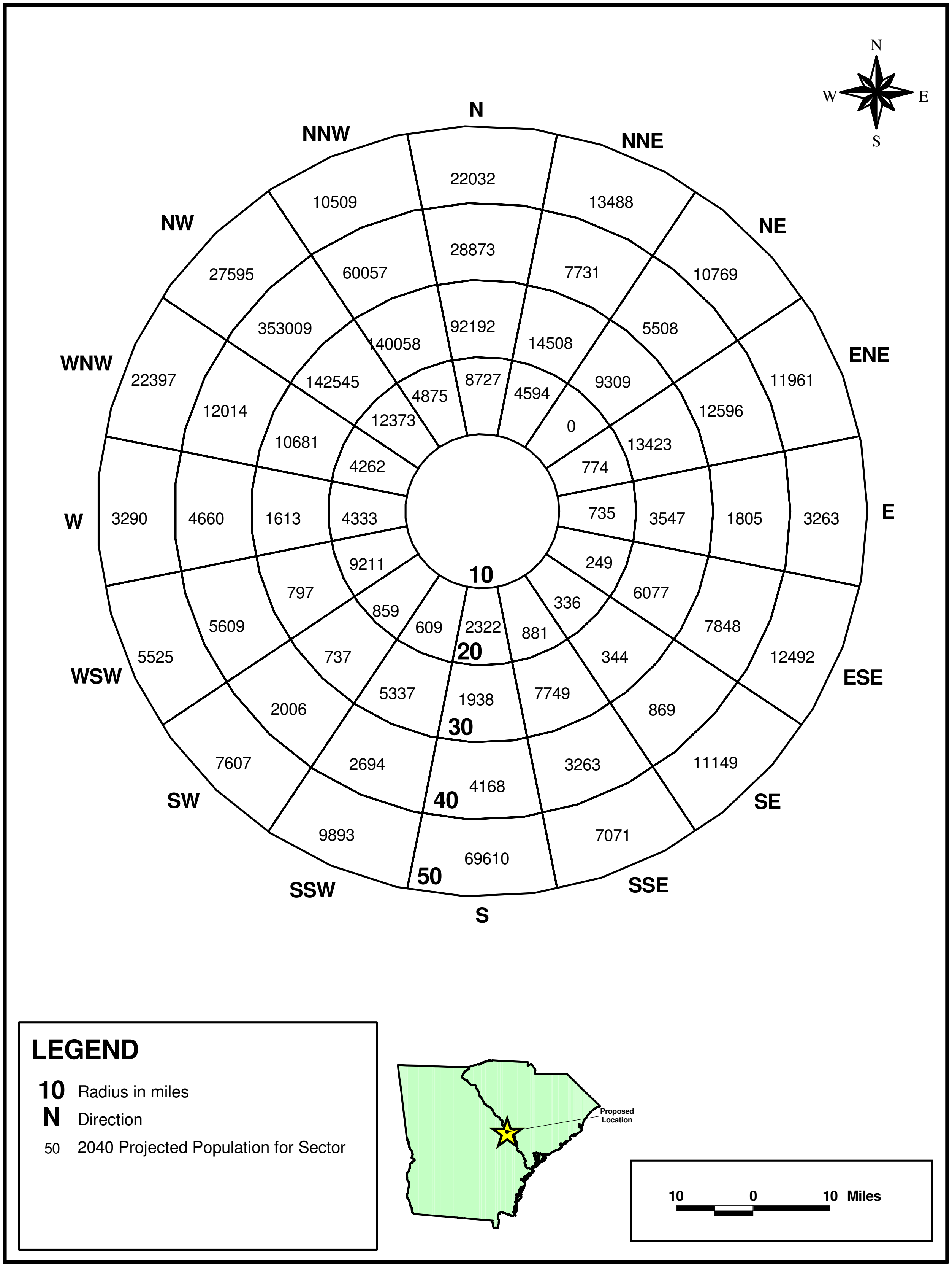

Figure 2.1-14 50-Mile Resident Population Distribution 2040

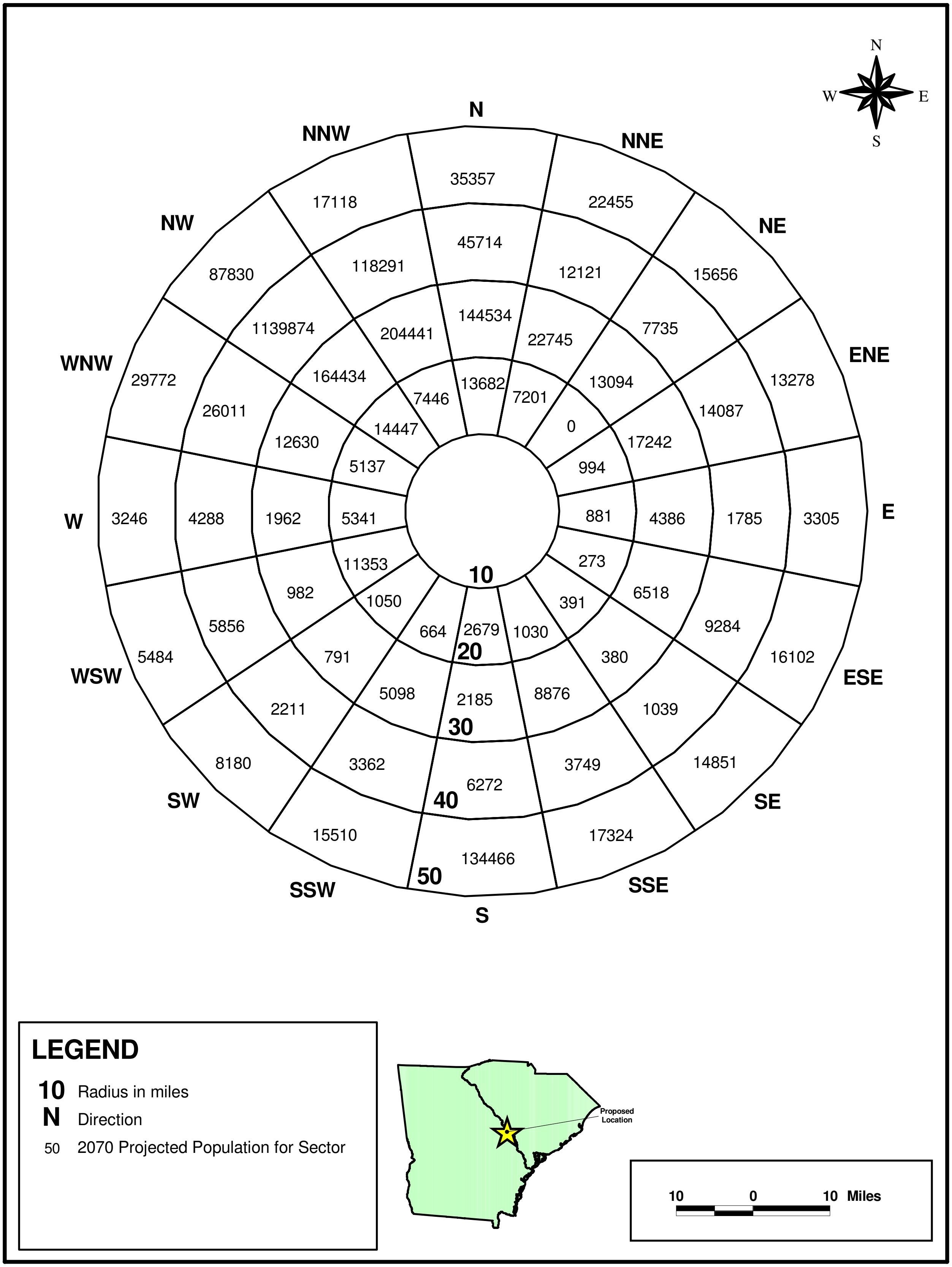

Figure 2.1-15 50-Mile Resident Population Distribution 2070

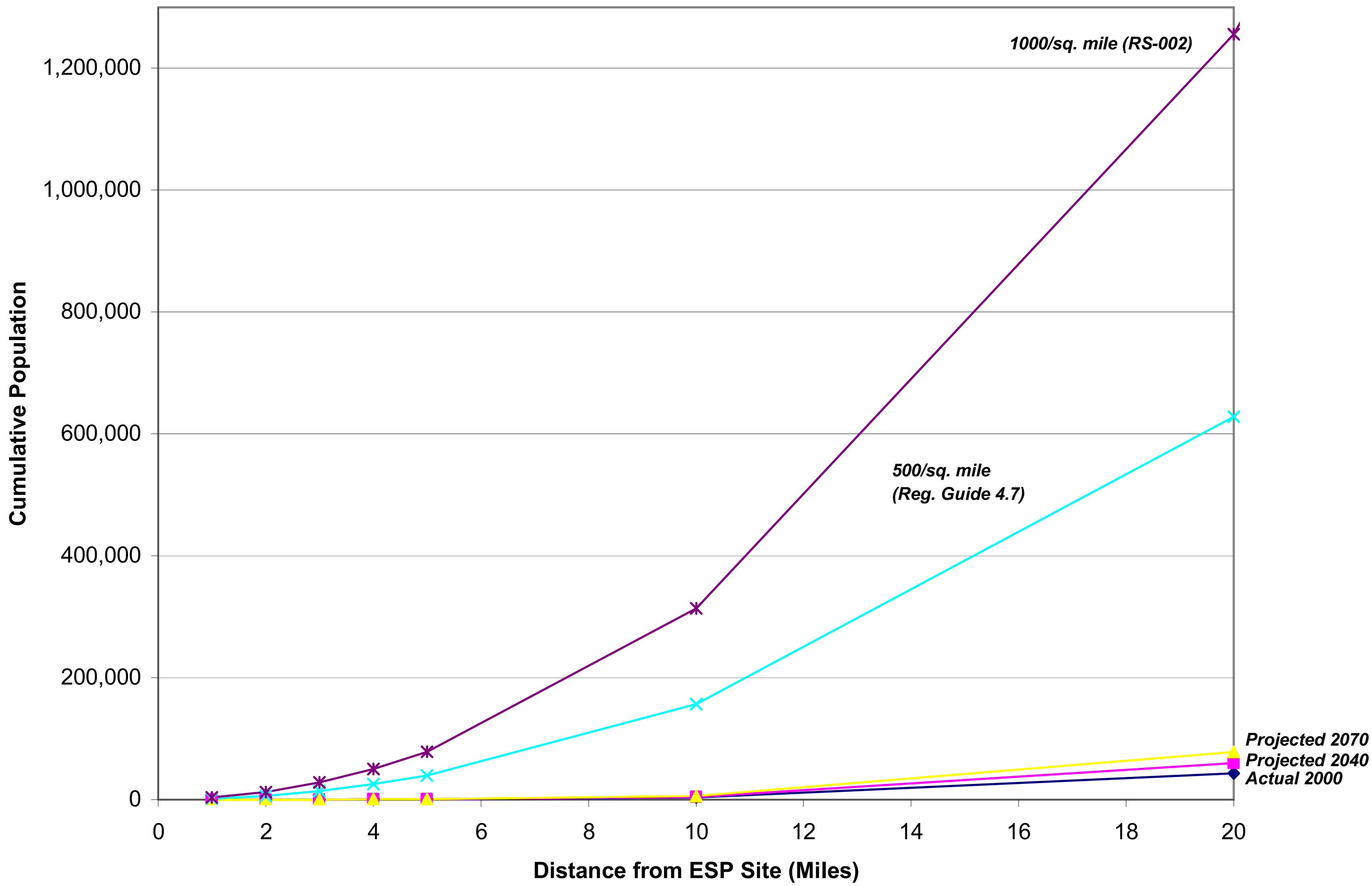

Figure 2.1-16 Population Compared to NRC Siting Criteria

Section 2.1 References

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2.2 Identification of Potential Hazards in Site Vicinity

2.2.1 Location of Nearby Industrial, Transportation, and Military Facilities

Within a 5-mile vicinity of the VEGP site, there are several major industrial facilities, one railroad, and one highway with commercial traffic. Specifically, the following transportation routes and facilities are shown on the indicated figures:

- Plant Wilson (see Figure 2.2-1)
- Savannah River Site (see Figure 2.2-2)
- Georgia State Highway 23 (see Figure 2.2-3)
- CSX Railroad (see Figure 2.2-1)
- A coal-fired steam plant operated by Washington Savannah River Company in D-Area of the SRS
- VEGP Unit 1 and Unit 2

Figures 2.2-2 and 2.2-3 shows the location of major industrial facilities, military bases, highway transportation routes, airports, railroads, and pipelines within a 25-mile radius of the site. In addition, Figure 2.2-2 shows nearby airways and military operation areas.

Items illustrated on the maps are described in Section 2.2.2. The only military facility within a 50-mile radius is Fort Gordon. The Fort Gordon U.S. Army Signal Corps training facility is barely within 25 miles of the VEGP site. The only major storage facility within 25 miles of the VEGP site, other than those at the SRS and at Chem-Nuclear Systems, is a group of oil storage tanks associated with the existing combustion turbine generators for Plant Wilson on the VEGP site.

2.2.2 Descriptions

2.2.2.1 Industrial Facilities

The Burke County Comprehensive Plan: 2010, Part 1 **(Burke 1991)** shows a relatively slow, stable population growth pattern for the county. This is indicative that the nearby industries have not experienced much growth.

The Comprehensive Plan also reveals that services and manufacturing industries dominate the top 10 employers in the county. Southern Nuclear and Samson Manufacturing Company (curtains and draperies) are the largest Burke County employers. Nearby industries also include the Chem-Nuclear Systems radioactive waste disposal site (18 miles away in South Carolina) operated by Duratek; Unitech Services Group nuclear laundry facility (21 miles away in South Carolina); and the facilities of the SRS (also in South Carolina). Table 2.2-1 lists the largest employers for the three-county region, based on recent data obtained for Burke County **(Burke 2005)** in Georgia, and nearby Aiken and Barnwell counties in South Carolina **(Aiken 2005; Barnwell 2005)**.

There currently are no projected major increases to industrial, military, or transportation facilities within a 25-mile radius of the VEGP site except for the development of the site for VEGP Units 3 and 4.

2.2.2.1.1 Savannah River Site

The SRS borders the Savannah River for approximately 17 miles opposite the VEGP site. It occupies an approximately circular area of 310 square miles (198,344 acres) encompassing parts of Aiken, Barnwell, and Allendale counties in South Carolina **(WSRC 2006)**. The SRS is owned by the DOE and operated by an integrated team led by Washington Savannah River Company (WSRC). The site is a closed government reservation except for through traffic on South Carolina Highway 125 (Savannah River Site Road A) and the CSX Railroad.

The SRS processes and stores nuclear materials in support of the national defense and U. S. non-proliferation efforts. The site also develops and deploys technologies to improve the environment and treat nuclear and hazardous wastes left from the Cold War. **(WSRC 2006)**

The following is a list of current and near-term operating facilities at the SRS and the activities conducted at these facilities **(WSRC 2006; DOE 2006)**:

- Separations facilities for processing irradiated materials (H Area).
- Waste management facilities that process, dispose or ship solid radioactive waste, hazardous waste, mixed waste, transuranic waste, and sanitary waste (E Area).
- The Defense Waste Processing Facility is processing high-level radioactive waste into stable borosilicate glass for disposal (S Area).
- The Savannah River National Laboratory (a process development laboratory to support production operations and containing two test reactors) and administrative facilities (A Area).

- The L Area Disassembly Basin which provides receipt and interim storage of research reactor fuel (L Area).
- Tritium Extraction Facility to extract tritium from fuel rods irradiated at TVA's reactors and to load the extracted tritium into canisters for shipment to the Department of Defense. Expected to begin operation in fiscal year 2007.
- Replenishment of tritium – recycling, purifying, and reloading nuclear weapons reservoirs.
- MOX Fuel Fabrication Facility (to be constructed) to manage and convert excess weapons-grade plutonium to a form that can be used in commercial nuclear power plants.
- Stabilization, management, and storage of plutonium materials (K Area).
- Salt waste Processing Facility to remove radioactive constituents from high-level waste (under construction).
- A variety of non-nuclear facilities necessary for plant operations.

Five nuclear production reactors and several small test reactors are deactivated and are awaiting decommissioning and decontamination.

The major waste storage areas for high-level waste are adjacent to the two separations areas and consist of two tank farms linked to the separations areas and to each other by pipelines with secondary containment. In addition, the SRS uses engineered concrete vaults and engineered trenches for the permanent disposal of solid low-level radioactive waste **(WSRC 2006)**. The deactivated reactors, separations areas, and waste storage areas are at least 4 miles from the nearest VEGP site boundary.

2.2.2.1.2 Unitech Services Nuclear Laundry Facility

Although not located within 5 miles of the VEGP site, the Unitech Services Nuclear Laundry Facility, located in the Barnwell County Industrial Park, is described due to its relative proximity to and association with the SRS (Figure 2.2-3). It was constructed by Unitech Service Group to provide radiological laundry, decontamination and respirator services. The facility has about 50 employees as of May 2006 **(Unitech 2006)**.

2.2.2.1.3 Chem-Nuclear Systems

Chem-Nuclear Systems developed, constructed, and operates the largest radioactive waste disposal site in the country near Barnwell, South Carolina (Figure 2.2-3). This site contains 308 acres, of which 235 have been deeded to the State of South Carolina as a designated exclusion area. Waste receipts are in the form of solids only; no liquids are accepted. Since the disposal facility began operation in 1971, about 28 million cubic feet, or 90 percent of the available disposal volume, have been used **(Chem-Nuclear 2006)**. The facility handles approximately 400 shipments of low-level spent fuel per year. The products and materials associated with Chem-Nuclear Systems are described in Table 2.2-2 **(Still 2005)**.

2.2.2.1.4 Georgia Power Company's Plant Wilson

Plant Wilson is located approximately 6,000 feet east-southeast from the proposed VEGP Units 3 & 4 footprint. The existing combustion turbine plant is an electrical peaking power station of Georgia Power Company. The plant consists of six combustion turbines with a total rated capacity of 351.6 MW. The storage capacity of the fuel storage tanks is 9,000,000 gallons.

2.2.2.1.5 VEGP Units 1 and 2

The existing VEGP Units 1 and 2 reactors are located about 3,600 ft and 3,900 ft, respectively west of the Savannah River. For these units, the exclusion area is the same as that for the proposed units and it is defined as an irregular shaped area which generally conforms to the site's boundary lines. There are no residents within the exclusion area, and there are no highways, railways, or waterways crossing the area. Besides the activities at Plant Wilson, the only other activities that may occur within the exclusion area that are unrelated to plant operations are those associated with the operation of the Visitor's Center. VEGP has made arrangements to control and, if necessary, evacuate the exclusion area in the event of an emergency.

2.2.2.2 Mining Activities

There are no mining activities within 5 miles of the VEGP site.

2.2.2.3 Roads

The nearest highway with commercial traffic is Georgia State Highway 23 (Figure 2.2-3). Segments of Georgia State Highways 23, 80, and 56 Spur are located within a 5-mile radius of the site. Other than traffic volumes, the Georgia Department of Transportation does not maintain data on the products and materials carried over these roads. However, major commercial traffic occurs only on State Highway 23, which serves as a major link between Augusta and Savannah. The heaviest truck traffic along State Highway 23 near the site consists primarily of timber and wood products and materials. State Highways 80 and 56 Spur serve primarily as minor transportation routes for local traffic. Available statistical data on personal injury accidents on these roads between 1999 and 2003 are presented in Table 2.2-3 **(GDT 2005)**.

2.2.2.4 Railroads

CSX is the nearest railroad with commercial traffic and is approximately 4.5 miles northeast of the VEGP site. CSX runs through and services the SRS. Major chemical substances identified as being carried by the CSX Railroad include cyclohexane, anhydrous ammonia, carbon monoxide, molten sulfur, and elevated temperature liquid. **(Murta 2006)**

Burke County has two local Norfolk Southern rail lines, one through Waynesboro and one through Midville. These are approximately 12 miles west of the VEGP site.

2.2.2.5 Waterways

The VEGP Units 3 & 4 footprint is located about 4,850 feet southwest of the Savannah River. In 1979, the last commercial shipment passed through the New Savannah Bluff Lock and Dam, located approximately 35 river miles north of the VEGP site **(USACE 2000)**. Since that time, there has been no commercial river traffic between Augusta and Savannah, and only limited commercial river traffic past the VEGP site **(DOE 1999)**. The small amount of traffic that does exist is primarily composed of barge-tug tows moving up and down the river channel out of the Port of Savannah. There are no locks or dams in the vicinity of the plant site. The proposed intake structure is located approximately 1,800 feet upstream of the existing VEGP Units 1 and 2 intake structure (see Figure 1-4).

In 2004, only 13 commercial vessels (8 upbound and 5 downbound) were recorded on the Savannah River below Augusta. Within this section of the river, a total of less than 500 tons of residual fuel oil were transported near or past the VEGP site. Except for residual fuel oil, no flammable or potentially explosive materials were transported on this portion of the Savannah River **(IWR 2004)**.

2.2.2.6 Airports, Airways, and Military Training Routes

2.2.2.6.1 Airports

There are no airports within 10 miles of the VEGP site. The closest airport, Burke County Airport, is approximately 16 miles west-southwest of the VEGP site. It has a 4,035-foot asphalt runway oriented 250^{o} WSW – 70^{o} ENE. The airport, which has a non-directional radio beacon for runway approach, is used by single-engine private aircraft and by crop-dusting operations. There are only two multi-engine and five single-engine aircraft based at the field. The average number of operations (landings and takeoffs are counted separately) is about 57 per week. Most operations are transient general aviation; only about 33 percent are local general aviation **(Burke Airport 2006)**.

The closest commercial airport is Augusta Regional Airport at Bush Field, which is located approximately 17 miles north-northwest of the VEGP site. It has an 8,000-foot primary runway oriented 170° SSE – 350° NNW and a 6,000-foot crosswind runway oriented 80° ENE – 260° WSW. FAA information effective April 13, 2006 indicates that 17 aircraft are based on the field. Ten of these are single-engine airplanes, four are multi-engines airplanes, and three are jet-engine airplanes. The average number of operations is about 91 per day. Most (40 percent) are general transient aviation, 24 percent are air taxi, 12 percent are local general aviation, 14 percent are commercial, and 10 percent are military **(FAA 2006)**. Based on the historical flight data recorded prior to 2005, projections for air traffic at Bush Field up to fiscal year 2025 are given in Table 2.2-4 **(APO 2006)**. Approach and departure paths at Bush Field are not aligned with the VEGP site; and no regular air traffic patterns for Bush Field extend into airspace over the VEGP site.

A small un-improved grass airstrip is located immediately north of the VEGP site (north of Hancock Landing Road and west of the Savannah River). At its closest point, the airstrip is more than 1.4 mile from the power block of the new units. This privately owned and operated airstrip has a 1,650-foot turf runway oriented 80° East – 260° West. Thus take-offs and landings are tangential to the site property and oriented away from the plant. While no FAA traffic information is available for this airstrip, informal communication with the owner/operator revealed that the airstrip is for personal use and the associated traffic consists only of small single-engine aircraft **(Rhodes 2006)**. In addition, there is a small helicopter landing pad on the VEGP site. This facility exists for corporate use and for use in case of emergency. The traffic associated with either of these facilities may be characterized as sporadic. Therefore, due to the small amount and the nature of the traffic, these facilities do not present a safety hazard to the VEGP site.

2.2.2.6.2 Airways

The centerline of Airway V185 is approximately 1.5 miles west of the VEGP site (Figure 2.2-2). Additionally, Airway V417 is about 12 miles northeast of the VEGP site, and Airway V70 is approximately 20 miles south of the VEGP site (Figure 2.2-2) **(FAA 2005)**. Due to its close proximity to the VEGP site, an evaluation of hazards from air traffic along the V185 airway is presented in Section 3.5.1.6. That evaluation shows that the presence of Airway V185 is not a safety concern for the VEGP site.

2.2.2.6.3 Military Training Routes

In August 2005, Shaw Air Force Base (AFB), South Carolina, issued a draft Environmental Impact Statement (EIS) **(Shaw 2005)** regarding implementing airspace modifications to the

Gamecock and Poinsett Military Operation Areas (MOAs) in South Carolina and the Bulldog MOAs in Georgia. The west edge of the Poinsett MOA is about 75 miles east-northeast of the VEGP site. The Gamecock MOAs are east of the Poinsett MOA. The proposed Gamecock E MOA would be created to form a "bridge," allowing maneuvering and training between the Gamecock MOAs and the Poinsett MOA. The east edge of the Bulldog MOAs is about 11 miles west of the VEGP site (see Figure 2.2-2). Because of the relatively long distances between the VEGP site and these MOAs, and their related training routes, no aircraft accident analysis is required for flight activities associated with these MOAs and their related training routes.

Under the proposed action, the airspace structure at Bulldog A MOA would be expanded to the east under the Bulldog B "shelf" to match the boundary of the existing Bulldog B. Mainly, the current 500-foot msl floor as allowed at Bulldog A would be laterally expanded into Bulldog B. Because the current Bulldog B floor is 10,000 feet msl, this lateral expansion would increase the airspace volume in the Bulldog MOAs. The overall distance from the MOA boundary to the VEGP site is unchanged.

Military aircraft in the Bulldog MOAs are expected to come mainly from Shaw AFB (about 32 miles east of Columbia, South Carolina) and McEntire Air National Guard Station (about 13 miles east-southeast of Columbia). Among the military training routes, VR97-1059 is located closest to the VEGP site. The distance between the centerline of VR97-1059 and the VEGP site is about 18 miles (Figure 2.2-2). The maximum route width of VR97-1059 is 20 nautical miles (NM); therefore, the width on either side of the route centerline is assumed to be 10 NM (11.5 miles). The VEGP site is located more than 6 miles from the edge of this training route. Additionally, the total number of military aircraft using route VR97-1059 is approximately 833 per year **(Shaw 2005)**.

According to RS-002, *Processing Applications for Early Site Permits*, May 2004 (RS-002), the aircraft accident probability for military training routes is considered to be less than 10^{-7} per year if the distance from the site is at least 5 statute miles from the edge of military training routes, including low-level training routes, except for those associated with a usage greater than 1,000 flights per year, or where activities may create an unusual stress situation.

In summary, the MOA use is projected to remain relatively unchanged and no modifications are proposed to the military routes. The VEGP site is located more than 5 statute miles from the edge of VR97-1059, and the total military flights using the same route is less than 1,000 per year; therefore, no aircraft accident analysis is required for flights using VR97-1059 **(Shaw 2005)**.

2.2.2.7 Natural Gas or Petroleum Pipelines

Three pipelines are within 25 miles of the VEGP site (Figure 2.2-3); however, none are located within 10 miles of the VEGP site.

Pipeline 1, located approximately 21 miles northeast of the VEGP site, is an 8-inch-diameter line constructed in 1959. It operates at a maximum pressure of 750 psi; is buried 3 feet deep; has 8-inch Rockwell isolation valves at 25-mile intervals; and carries natural gas. It is not used for storage.

Pipeline 2, located approximately 19 miles southwest of the VEGP site, has a 14-inch-diameter line constructed in 1954 and a 20-inch-diameter line constructed in 1977. Both lines are buried 3-feet deep; operate at a maximum pressure of 1,250 psi; have buried Rockwell isolation valves every 8 to 9 miles; and carry natural gas. They are not used for storage.

Pipeline 3, located approximately 20 miles northwest of the VEGP site, has two 16-inch-diameter lines constructed in 1953 and 1957. Both operate at a maximum pressure of 1,250 psi; are buried 3 feet deep; have buried Rockwell isolation valves every 8 to 9 miles; and carry natural gas.

Because the pipelines identified are well over 10 miles from the VEGP site, there is no need to identify the locations of individual pipeline valves.

2.2.2.8 Military Facilities

There are no military facilities within 5 miles of the VEGP site.

2.2.2.9 VEGP Units 1 and 2 Storage Tanks / Chemicals

Chemicals currently stored at the VEGP site are presented in Table 2.2-5.

2.2.3 Evaluation of Potential Accidents

Analyses were performed in order to evaluate control room habitability following potential toxic chemical releases within a 5-mile radius of the VEGP site. The postulated accidents which would result in a chemical release were analyzed at the following locations.

- Nearby transportation routes (Savannah River, Highway 23, and CSX Railroad)
- Nearby chemical and fuel storage facilities (Savannah River Site, Plant Wilson)
- Onsite chemical storage tanks

Analyses of potential hazards to the existing units were reviewed for applicability to the new units. In addition, new chemicals identified were evaluated or analyzed to determine their impact to the new units. As described below, in each case, the analyses concluded that the potential for hazard is minimal and will not affect safe operation of the new units.

2.2.3.1 Explosion and Flammable Vapor Clouds

The effects of explosion and formation of flammable vapor clouds from the nearby sources are evaluated below.

2.2.3.1.1 Truck Traffic

Segments of Georgia State Highways 23, 80, and 56 Spur are located within a 5-mile radius of the VEGP site. Major commercial traffic occurs only on State Highway 23, which serves as a major link between Augusta and Savannah, Georgia.

An analysis of truck-borne hazards was performed which identified that chlorine, anhydrous ammonia, liquid nitrogen, phosphoric acid, nitric acid, and diesel oil are transported on nearby Highway 23. The allowable and actual distances of hazardous chemicals transported on highways were evaluated according to NRC Regulatory Guide 1.91, Revision 1, *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants*. (RG 1.91). RG 1.91 cites 1 psi as a conservative value of peak positive incident overpressure, below which no significant damage would be expected. The analysis demonstrated that substances stored or transported within a 5-mile radius of the VEGP site, as well as explosions and flammable vapor clouds induced by these chemicals will not adversely affect safe operation of the plant

2.2.3.1.2 Pipelines and Mining Facilities

No natural gas pipeline or mining facilities are located within 10 miles of the VEGP site. No pipelines carrying potentially hazardous materials are located within 5 miles of the VEGP site. Therefore, the potential for hazards from these sources are minimal and will not adversely affect safe operation of the plant.

2.2.3.1.3 Waterway Traffic

The VEGP site is located along the Savannah River. Commercial traffic on the Savannah River is composed of barge-tug tows traveling up and down the river channel from Savannah, Georgia. The only chemical substance transported along the river that could potentially cause hazardous effects is identified as fuel oil **(IWR 2004)**. This substance is neither a solid explosive material, nor is it a hydrocarbon which has been liquefied under pressure. Therefore, in accordance with RG-1.91, this material is not required to be evaluated for explosion.

In addition, an analysis for VEGP Units 1 and 2 determined that the concentration of flammable material in the vapor-space of the tanks carrying the fuel oil is well below the lower limit of flammability. In that case, an explosion of fuel oil tanks is not considered a credible event. The analyses also show that flammable vapor clouds induced by the release of these chemicals will not adversely affect safe operation of the plant. The proposed VEGP Units 3 and 4 will be farther away from the river than the existing VEGP units. Therefore the potential for hazards from waterway traffic is minimal and will not affect safe operation of the new units.

2.2.3.1.4 Railroad Traffic

The only railroad within a 5-mile radius of the VEGP site is the CSX Railroad (approximately 4.5 miles northwest), which runs through, and services, the SRS. A hazards analysis performed for VEGP Units 1 and 2 showed that due to the long distance separating the railroad and the VEGP site, explosions and flammable vapor clouds induced by these chemicals will not adversely affect safe operation of the existing units. Since the proposed VEGP Units 3 and 4 will be located farther away from the railroad line than the existing units, the possibility of adverse effects from explosions and flammable vapor clouds is even smaller for the new units. Information obtained from CSX (Director of Infrastructure Security) **(Murta 2006)** indicates that the top five substances carried by CSX during 2005 which qualified as DOT hazardous chemicals are cyclohexane, anhydrous ammonia, carbon monoxide, molten sulfur and elevated temperature material liquids (ETMLs).

Evaluations were made for each of the above chemicals. Some of the above chemicals were already analyzed in a previous analysis for effect on the existing units, and some were evaluated specifically for their potential effect on the new units. In each case, the evaluations concluded that the potential hazard from the chemicals is minimal and will not affect the safe operation of the new units. ETMLs are not necessarily flammable. According to the DOT, the hazard from ETMLs is the potential to cause contact burns due to the elevated temperature of the substance. Because of the long distance separation between the CSX Railroad and the new units, no direct contact with these substances is expected. Therefore, no adverse impact is expected from the accidental releases of the ETML substances.

Potential adverse impact caused by accidental release of cyclohexane was analyzed because it is flammable and has an established toxic threshold limit value (TLV). The analysis has concluded that the accidental release of cyclohexane from a railcar will not have adverse effects to the control room operators. Additionally, based on the total flammable mass estimated in the analysis, no adverse explosion impact is expected due to the traveling vapor cloud resulting from an accidental cyclohexane railcar release.

2.2.3.2 Hazardous Chemicals

NRC Regulatory Guide 1.78, Rev. 1, *Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*, requires evaluation of control room habitability for a postulated release of chemicals stored within 5 miles of the control room. As described in Subsection 2.2.2, no manufacturing plants, chemical plants, storage facilities, or oil or gas pipelines are located within 5 miles of the VEGP site. Therefore, three scenarios were evaluated:

1. Potential hazards from chemicals transported on routes within a 5-mile radius of the site, at a frequency of 10 or more per year, and with weights outlined in RG 1.78
2. Potential hazards from major depots or storage areas
3. Potential hazards from onsite storage tanks

Each hazard is discussed and evaluated below. The VEGP Units 1 and 2 analysis was reviewed for applicability to Units 3 and 4 for the effects from each of these hazards. The review determined that the impact to the new units for each of these postulated events is bounded by the impact to Units 1 and 2.

2.2.3.2.1 Release of Hazardous Chemicals Due to a Transportation Accident

Three routes (Georgia State Highways 23, 80, and 56) pass within 5 miles of the VEGP site. The VEGP site is located along the Savannah River. Barge traffic moves up and down the river channel nearby the plant site.

Hazardous chemicals transported near the VEGP site were analyzed. The critical distance (given by $kW^{1/3}$ in Regulatory Guide 1.91) that could cause overpressures to safety-related structures is 686 m. This scenario is caused by the ammonia release from a railroad tank car. Because of the relatively long distance (about 4.8 miles) between the railroad and the VEGP site, if an explosion due to an ammonia release from a railroad tank car could occur, it would occur at a distance great enough not to pose an overpressure hazard to the safety-related structures. The hazardous chemical sources due to a transportation accident were analyzed using the same methodology as for onsite toxic hazards. The results of the analysis indicated that control rooms of all VEGP units would remain habitable for all chemicals, and only for gasoline and ammonia would the control room operators be required to take emergency action.

2.2.3.2.2 Potential Hazard from Major Depots or Storage Areas

The only major depots or storage areas within 5 miles of the VEGP site are those at the SRS and the Wilson combustion turbine plant. The SRS borders the Savannah River for approximately 17 miles opposite the VEGP site. The combustion turbine plant is located approximately 6,000 feet from the new AP1000 units' power block.

The chemicals stored at the combustion turbine plant, with the exception of No. 2 fuel oil and sulfuric acid, are in small quantities. These oils and solvents have low volatility and toxicity, and there would be no potential hazard to the new AP1000 unit control rooms habitability from these substances. The three No. 2 fuel oil tanks located at east of Service Building for the combustion turbine plant have a capacity of 3,000,000 gallons each **(Wilson Plant 2006)**. The tanks are surrounded by a dike, which would prevent a fuel leak from spreading into a large spill area.

The hazardous chemical sources at the SRS and the Wilson combustion turbine plant were analyzed using the same methodology as for onsite toxic hazards. The results of the analysis indicate that control rooms for all VEGP units would remain habitable for all chemical releases or spills, and only for ammonia would the control room operator be required to take emergency action. Compared to the existing VEGP Units 1 and 2 power block area, the new AP1000 power block area is approximately 1,400 feet further from the Savannah River. Therefore, the impact of any accidental chemical release will be expected to be even smaller for Units 3 and 4.

2.2.3.2.3 Potential Hazard from Onsite Storage Tanks

The storage facilities on the VEGP site are listed in Table 2.2.-5. Many of the chemicals listed in that table are excluded from further consideration due to their properties (e.g., low volatility or low toxicity) or due to the relatively small quantities that are stored. The guidelines and methodologies of NRC NUREG-0570, *Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release* were used to determine the release rates and concentrations of toxic gases at the control room air intake for existing VEGP Units 1 and 2. This analysis shows that the control room would remain habitable for most release scenarios without any operator action and that there would be sufficient time for control room operators to take emergency action for the remaining release scenarios. For all releases except ammonia and hydrazine, the average concentration over an 8-hour period would never exceed the long-term toxicity limit. Where the long-term limit would be exceeded, it has been shown for VEGP Units 1 and 2 that at least 2 minutes would be available between detection and the time the short-term toxicity limit (as defined in RG 1.78) would be reached. Since both ammonia and hydrazine are stored northeast of the VEGP Unit 1 reactor, these chemicals would be separated by a minimum of about 1,800-feet from the location of the new AP1000 units on the VEGP site.

Therefore, the impact on the new AP1000 units due to accidental ammonia or hydrazine releases will be expected to be smaller than those for existing Units 1 and 2.

As shown in Table 2.2-5, some chemicals previously used for Units 1 and 2 have recently been replaced. Phosphoric acid (Nalco 3DT177) is one of the new chemicals used for the existing Units 1 and 2 that was identified to be toxic. This material is stored in a 5050-gallon tank located between two existing cooling towers. An analysis has shown that the phosphoric acid concentrations outside the new control room air intake are much lower than the threshold limit values following an accidental release. Since this material is not flammable, the explosion effect was not evaluated.

Section 6.4 of the Westinghouse AP1000 Design Control Document addresses habitability systems for the new AP1000 units and concludes that the DCD-listed sources of AP1000 onsite chemicals (see Table 2.2-6) do not represent a toxic hazard to AP1000 control room personnel **(Westinghouse 2005)**.

2.2.3.3 Fires

In the vicinity of the VEGP site, the following potential fire hazards exist:

a. Fire due to a transportation accident

b. Fire due to an oil or gas pipeline rupture accident

c. Forest fire

d. Fire due to an accident at industrial storage facilities

e. Fire due to an onsite storage tank spill

An analysis was performed for VEGP Units 1 and 2 which evaluated the potential fire hazards identified above. For each event, the analysis concluded that combustion products would not reach concentrations in the VEGP Unit 1 and 2 control room that approached toxicity limits. In addition, the temperature rise for each event was calculated to be less than the threshold for causing thermal damage to any safety-related structures at VEGP Units 1 and 2. For all of the fire events evaluated, the location of the new AP1000 units on the VEGP site is the same distance from the source of the fire as the existing VEGP Units 1 and 2, or is further removed, and therefore the same conclusions concerning impact may be made.

2.2.3.4 Radiological Hazards

The hazard due to the release of radioactive material from either VEGP Units 1 and 2 or the facilities at SRS, as a result of normal operations or an unanticipated event, would not threaten safety of the new units. Smoke detectors, radiation detectors, and associated control equipment are installed at various plant locations as necessary to provide the appropriate operation of the systems. Radiation monitoring of the main control room environment is provided by the radiation monitoring system (RMS). The habitability systems for the AP1000 are capable of maintaining the main control room environment suitable for prolong occupancy throughout the duration of the postulated accidents that require protection from external fire, smoke and airborne radioactivity. Automatic actuation of the individual systems that perform a habitability systems function is provided. In addition, safety related structures, systems, and components for the AP1000 have been designed to withstand the effects of radiological events and the consequential releases which would bound the contamination from a release from either of these potential sources. **(Westinghouse 2005)**

Table 2.2-1 Nearby Largest Employers

Burke County, GA	Aiken County, SC	Barnwell County, SC
Burke County Hospital	Westinghouse Savannah River	Dixie Narco Inc.
Kwikset Corporation	Aiken County Board of Education	Barnwell School District #45
Management Analysis & Utilization Inc.	Bechtel Savannah River Company	Ness Motley Loadholt Richardson
Samson Manufacturing Inc.	Avondale Mills Inc.	Sara Lee Sock Company Inc.
Southern Nuclear Operating Co. Inc.	Kimberly-Clark Corporation	Excel Comfort Systems Inc.

Table 2.2-2 Description of Products and Materials: Chem-Nuclear Systems, Inc.

Products or Materials	Status	Annual Amounts	Shipment
Isotopes – Including Co-60 (by far largest quantity),Fe-55, and Ni-63	Stored	0.50 x 10^6 ft^3 (7/1/04-6/30/05) 0.45 x 10^6 ft^3 (7/1/05-6/30/06) 0.40 x 10^6 ft^3 (7/1/06-6/30/07) 0.35 x 10^6 ft^3 (7/1/07-7/30/08)	400/year; average volume - 150 ft^3; largest volume for a single shipment - 8,000 ft^3

Note: The above materials are transported via highway.

Table 2.2-3 Burke County, Georgia Transportation Accident Data Within 5 Miles of the VEGP Site

	1999	2000	2001	2002	2003
State Route 80					
Accidents					
Injuries	5	0	10	3	3
Fatalities	0	0	0	0	0
State Route 23					
Accidents					
Injuries	14	3	9	15	12
Fatalities	3	0	0	0	0
State Route 56C					
Accidents					
Injuries	0	0	0	0	0
Fatalities	0	0	0	0	0

Table 2.2-4 Bush Field (Augusta) Terminal Area Forecast Fiscal Years 1990–2025 Total Flights

Year	Total[a]
1990	47981
1991	38455
1992	37682
1993	36246
1994	33057
1995	34008
1996	33346
1997	34459
1998	34428
1999	37631
2000	36961
2001	35222
2002	34617
2003	33916
2004	35561
2005	27917
2006	28330
2007	28753
2008	29184
2009	29625
2010	30074
2011	30532
2012	31001
2013	31479
2014	31967
2015	32305
2016	32647
2017	32995
2018	33347
2019	33703
2020	34065
2021	34430
2022	34801
2023	35178
2024	35558
2025	35945

[a] Itinerant Operations (air taxi & commercial + general aviation + military)

Table 2.2-5 VEGP Onsite Chemical Storage

Material	Quantity	Location
Kitchen Grease	550 gallons	Underground tank east of service building
No. 2 Diesel Fuel	1,500 gallons	South of PESB
No. 2 Diesel Fuel	160,000 gallons*	East of U1 diesel generator building
No. 2 Diesel Fuel	160,000 gallons*	West of U2 diesel generator building
Hydrazine	6,000 gallons	East of turbine building
Methoxypropylamine	12,780 gallons	East of turbine building
Clean Lube Oil	30,000 gallons	East of turbine building
Dirty Lube Oil	30,000 gallons	East of turbine building
No. 2 Diesel Fuel	100,000 gallons	East of turbine building
No. 2 Diesel Fuel	560 gallons	Fire protection pumphouse
No. 2 Diesel Fuel	560 gallons	Fire protection pumphouse
Main Turbine Lube Oil	12,800 gallons	Turbine building
Main Turbine Lube Oil	12,800 gallons	Turbine building
SGFP Lube Oil	2,800 gallons	Turbine building
SGFP Lube Oil	2,800 gallons	Turbine building
EHC Fluid	1,600 gallons	Turbine building
EHC Fluid	1,600 gallons	Turbine building
No. 2 Diesel Fuel	1,250 gallons	U1 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U1 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U2 diesel generator building
No. 2 Diesel Fuel	1,250 gallons	U2 diesel generator building
Unleaded Gasoline	6,000 gallons	East of receiving warehouse
No. 2 Diesel Fuel	3,000 gallons	East of receiving warehouse
Sodium Hypochlorite	6,700 gallons	Main Cooling towers
Dispersant**	4,400 gallons	Main Cooling towers
MS Corrosion Inhibitor***	5,050 gallons	Main Cooling towers
Copper Corrosion Inhibitor****	2,200 gallons	Main Cooling towers
Kerosene	7,000 gallons	Fire training area
Sodium Hypochlorite	250 gallons	East of plant potable water storage tank
Boric Acid	46,000 gallons	U1 aux building
Boric Acid	46,000 gallons	U2 aux building
Used Oil	4,000 gallons	NW of admin support building
Used Oil	5,000 gallons	NW of admin support building
Sodium Bromide	4,000 gallons	Main Cooling towers
Nalco STABREX	6,700 gallons	Main Cooling towers
Sodium Hypochlorite	200 gallons	Plant potable water building
Sodium Phosphate, Tribasic	200 gallons	Plant potable water building
Copper Corrosion Inhibitor****	200 gallons	U1 NSCW tower chemical addition building
Copper Corrosion Inhibitor****	200 gallons	U2 NSCW tower chemical addition building
Ammonium Bisulfite	200 gallons	Circulating water dechlorination building

* Actually two 80,000 gallon tanks that are interconnected and function as one tank.
** Currently using Nalco 3DT102, swapping to Nalco 3DT190 during summer 2006.
*** Currently using Nalco 73297, swapping to Nalco 3DT177 during summer 2006.
**** Currently using Nalco 1336.

Table 2.2-6 AP1000 Onsite Chemicals

Material	State	Location
Hydrogen	Gas	Gas storage
Nitrogen	Liquid	Turbine building
CO_2	Liquid	Turbine building
Oxygen Scavenger	Liquid	Turbine building
pH Addition	Liquid	Turbine building
Sulfuric Acid	Liquid	Turbine building
Sodium Hydroxide	Liquid	Turbine building
Dispersant[a]	Liquid	Turbine building
Fuel Oil	Liquid	DG fuel oil storage tank/DG building/ Turbine building/ Annex building
Corrosion Inhibitor	Liquid	Turbine building
Scale Inhibitor	Liquid	Turbine building
Biocide/Disinfectant	Liquid	Turbine building
Algaecide	Liquid	Turbine building

[a]Site specific, by Combined License applicant

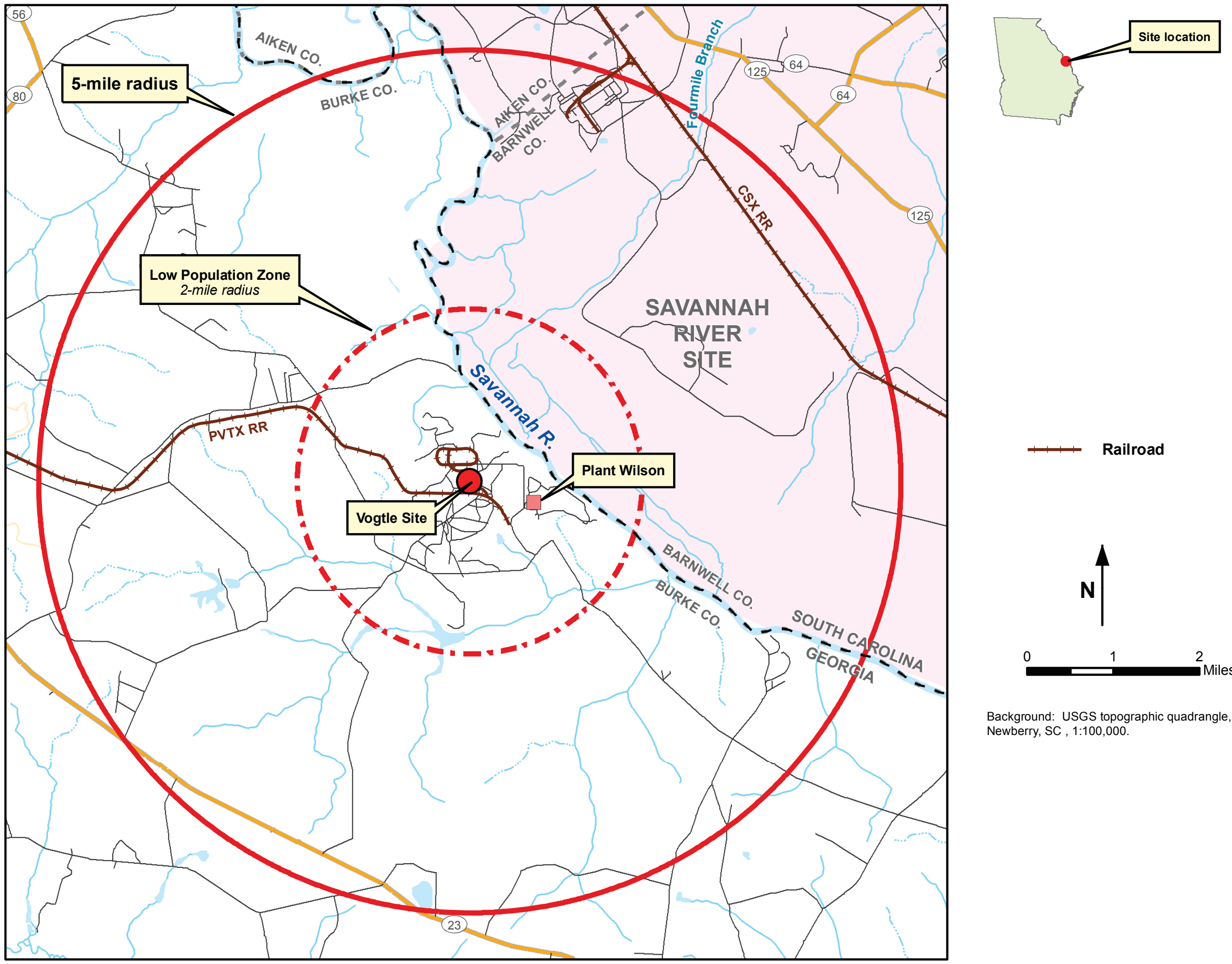

Figure 2.2-1 Site Vicinity Map

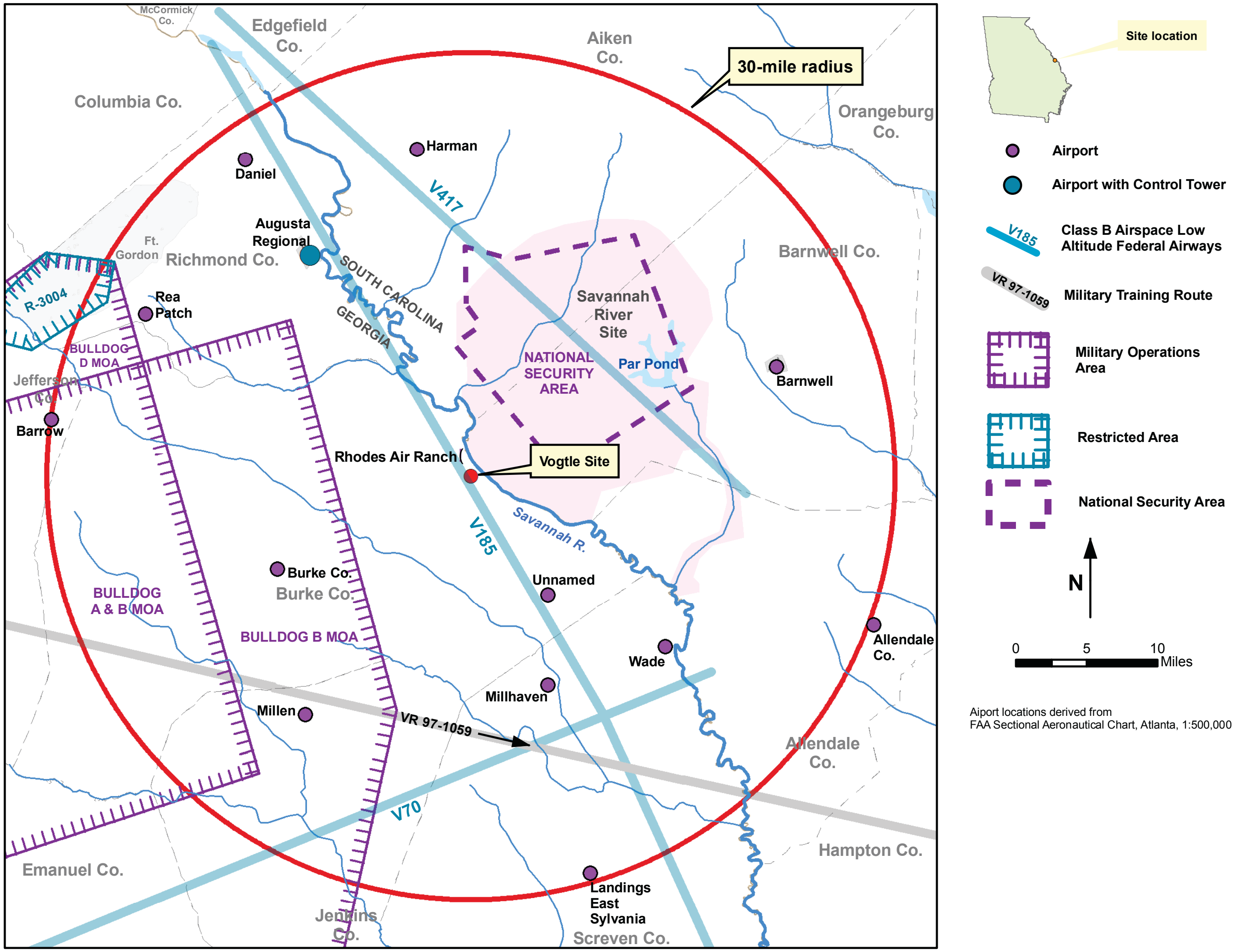

Figure 2.2-2 Airports within 30 miles of VEGP

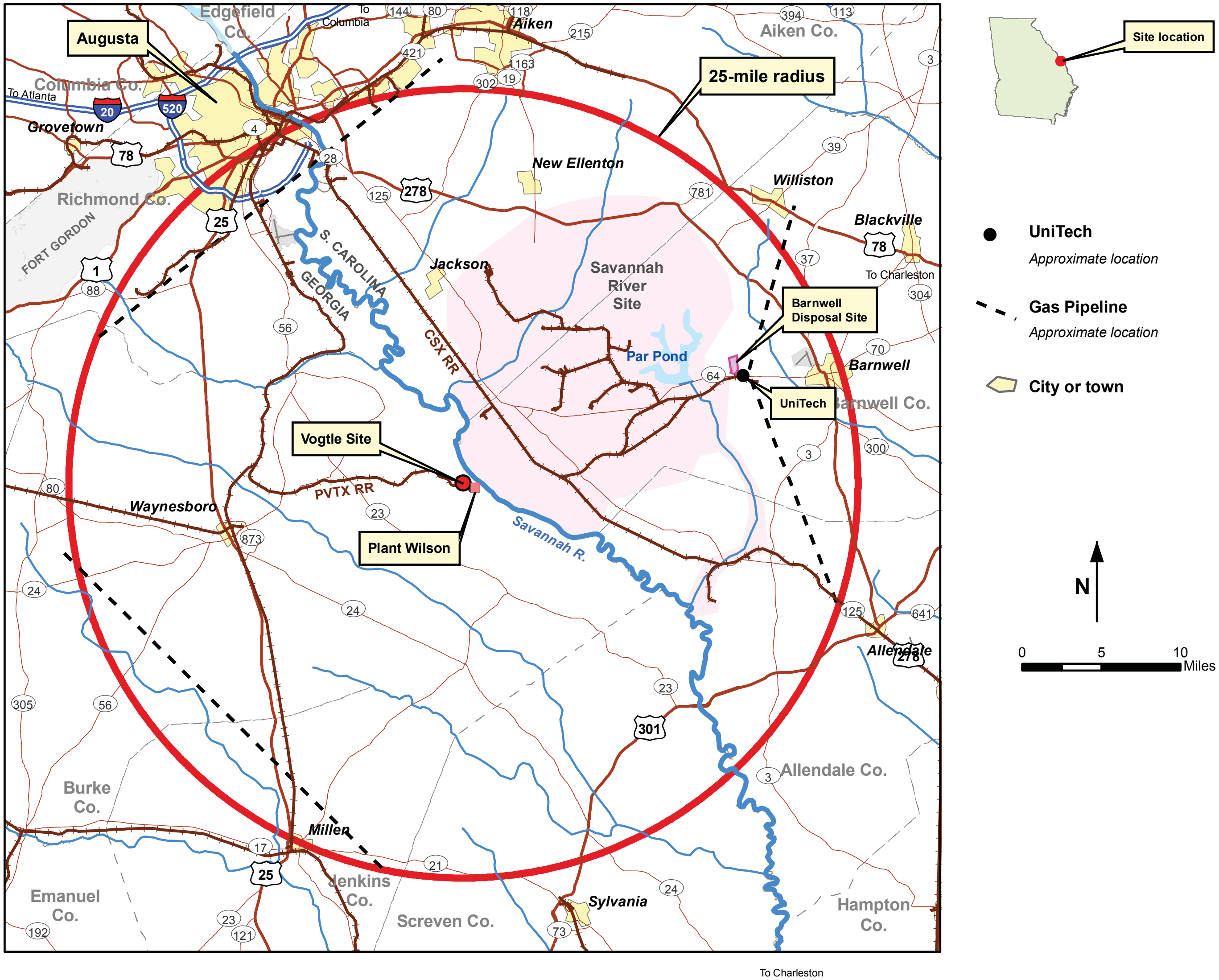

Figure 2.2-3 Industrial Facilities within 25 miles of VEGP

Section 2.2 References

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2.3 Meteorology

This section describes the regional and local climatological and meteorological characteristics applicable to the VEGP site for consideration in the design and operating bases of safety- and/or non-safety related structures, systems and components for proposed VEGP Units 3 and 4. This section also provides site-specific meteorological information for use in evaluating construction-related, routine operational, and hypothetical accidental releases to the atmosphere.

2.3.1 Regional Climatology

The VEGP site is located in the region known as the Upper Coastal Plain, lying between the Appalachian Mountains and the Atlantic Ocean, just south of the Fall Line that separates the Piedmont from the Coastal Plain. Elevation is generally 150 to 250 ft above sea level in this region, which is cut by the valley of the Savannah River. The river valley ranges from 2 to 5 mi wide near the VEGP site.

2.3.1.1 Data Sources

SNC used several sources of data to characterize regional climatological conditions pertinent to the VEGP site. The National Climatic Data Center (NCDC) compiled data from the first-order National Weather Service (NWS) station in Augusta, Georgia, and from seven other nearby locations in its network of cooperative observer stations.

These climatological observing stations are located in Burke, Richmond, Jenkins, and Screven Counties, Georgia, and in Aiken, Barnwell, and Orangeburg Counties, South Carolina. Table 2.3-1 identifies the specific stations and lists their approximate distance and direction from the existing reactors at the VEGP site. Figure 2.3-1 illustrates these station locations relative to the VEGP site.

Normals (i.e., 30-year averages), means, and extremes of temperature, rainfall, and snowfall are based on the:

- *2004 Local Climatological Data, Annual Summary with Comparative Data for Augusta, Georgia* **(NCDC 2005a)**
- *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries* **(NCDC 2005b)**
- *Climatography of the United States, No. 81, 1971-2000, U.S. Monthly Climate Normals* **(NCDC 2002a)**

- Southeast Regional Climate Center (SERCC), *Historical Climate Summaries and Normals for the Southeast* **(SERCC 2006).**
- *Cooperative Summary of the Day, TD3200, Period of Record Through 2001, for the Eastern United States, Puerto Rico and the Virgin Islands* **(NCDC 2002c)**.

First-order NWS stations also record measurements, typically on an hourly basis, of other weather elements, including winds, several indicators of atmospheric moisture content (i.e., relative humidity, dew point, and wet-bulb temperatures), and barometric pressure, as well as other observations when those conditions occur (e.g., fog, thunderstorms). Table 2.3-2, excerpted from the 2004 local climatological data (LCD) summary for the Augusta NWS Station, presents the long-term characteristics of these parameters.

The following data sources were also used in describing climatological characteristics of the VEGP site area and region:

- *Solar and Meteorological Surface Observation Network, 1961-1990, Volume 1, Eastern U.S.* **(NCDC-NREL 1993)**
- *Hourly United States Weather Observations, 1990-1995* **(NCDC 1997)**
- *Engineering Weather Data, 2000 Interactive Edition, Version 1.0* **(AFCCC-NCDC 1999)**
- *Minimum Design Loads for Buildings and Other Structures* **(ASCE 2002)**
- *Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian,* Hydrometeorological Report No. 53, June 1980 (NUREG/CR-1486)
- *Storm Events for Georgia and South Carolina,* Tornado Event Summaries, accessed July 2005 and January 2006 **(NCDC 2006a)**
- *Historical Hurricane Tracks Storm Query,* 1851 through 2004 **(NOAA-CSC 2005)**
- *The Climate Atlas of the United States* **(NCDC 2002b)**
- *Storm Events for Georgia and South Carolina,* Hail Event and Snow and Ice Event Summaries for Burke, Jenkins, Richmond, and Screven Counties in Georgia, and Aiken, Allendale, and Barnwell Counties in South Carolina **(NCDC 2006b)**
- *Storm Data (and Unusual Weather Phenomena with Late Reports and Corrections),* January 1959 (Volume 1, Number 1) to January 2004 (Volume 42, Number 1) **(NCDC 2004)**
- *Air Stagnation Climatology for the United States (1948-1998)* **(Wang and Angell 1999)**
- *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States* **(Holzworth 1972)**

2.3.1.2 General Climate

The general climate in this region is characterized by mild, short winters; long periods of mild sunny weather in the autumn; somewhat more windy but mild weather in spring; and long, hot summers.

The regional climate is predominately influenced by the Azores high-pressure system. Due to the clockwise circulation around the western extent of the Azores High, maritime tropical air mass characteristics prevail much of the year, especially during the summer with the establishment of the Bermuda High and the Gulf High. Together, these systems govern Georgia's summertime temperature and precipitation patterns. This macro-circulation feature also has an effect on the frequency of high air pollution potential in the VEGP site region. These characteristics and their relationship to the Bermuda High, especially in the late summer and autumn, are addressed in Section 2.3.1.6.

This macro-scale circulation feature continues during the transitional seasons and winter months; however, it is regularly disrupted by the passage of synoptic- and meso-scale weather systems. During winter, cold air masses may briefly intrude into the region with the cyclonic (i.e., counter-clockwise) northerly flow that follows the passage of low-pressure systems. These systems frequently originate in the continental interior around Colorado, pick up moisture-laden air due to southwesterly through southeasterly airflow in advance of the system, and result in a variety of precipitation events that include rain, snow, sleet, and freezing rain or mixtures, depending on the temperature characteristics of the weather system itself and the temperature of the underlying air (see Section 2.3.1.3.5). Similar cold air intrusion and precipitation patterns may also be associated with secondary low-pressure systems that form in the eastern Gulf of Mexico or along the Atlantic Coast and move northeastward along the coast (also referred to as "nor'easters").

Larger and relatively more persistent outbreaks of very cold, dry air associated with massive high-pressure systems that move southeastward out of Canada also periodically affect the VEGP site region. These weather conditions are moderated by the Appalachian Mountains to the northwest, which shelter the region in winter from these cold air masses that sweep down through the continental interior. In general, the cold air that does reach the VEGP site area is warmed by its descent to the relatively lower elevations of the region, as well as by modification due to heating as it passes over the land.

Monthly precipitation exhibits a cyclical pattern, with one maximum during the winter into early spring and a second maximum during late spring into summer (see Table 2.3-2). The winter and early spring maximum is associated with low-pressure systems moving eastward and northward through the Gulf States and up the Atlantic Coast, drawing in warm, moist air from the Gulf of Mexico and the Atlantic Ocean. These air masses receive little modification as they move into the region. The late spring and summer maximum is due to thunderstorm activity.

Heavy precipitation associated with late summer and early autumn tropical cyclones, as discussed in Section 2.3.1.3.3, is not uncommon. The VEGP site is located far enough inland that the strong winds associated with tropical cyclones are much reduced by the time that such systems affect the site area.

2.3.1.3 Severe Weather

2.3.1.3.1 Extreme Winds

Estimating the wind loading on plant structures for design and operating bases considers the "basic" wind speed, which is the "3-second gust speed at 33 ft (10 m) above the ground in Exposure Category C," as defined in Sections 6.2 and 6.3 of the ASCE-SEI design standard, *Minimum Design Loads for Buildings and Other Structures* **(ASCE 2002)**.

The basic wind speed for the VEGP site is about 97 mph, as estimated by linear interpolation from the plot of basic wind speeds in Figure 6-1 of ASCE (2002) for that portion of the U.S. that includes the VEGP site **(ASCE 2002)**. This interpolated value is about 7.5 percent higher than the basic wind speed reported in the Engineering Weather Data summary for the Augusta (Bush Field) NWS Station (i.e., 90 mph) **(AFCCC-NCDC 1999)**, which is located about 20 mi northwest of the VEGP site. The former value is, therefore, considered to be a reasonably conservative indicator of the basic wind speed.

From a probabilistic standpoint, these values are associated with a mean recurrence interval of 50 years. Section C6.0 of the ASCE-SEI design standard provides conversion factors for estimating 3-second-gust wind speeds for other recurrence intervals **(ASCE 2002)**. Based on this guidance, the 100-year return period value is determined by multiplying the 50-year return period value by a scaling factor of 1.07, which yields a 100-year return period 3-second-gust wind speed for the VEGP site of about 104 mph.

2.3.1.3.2 Tornadoes

The design-basis tornado (DBT) characteristics applicable to structures, systems, and components important to safety at the proposed VEGP site include the following parameters as identified in Draft Regulatory Guide DG-1143, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants, Proposed Revision 1 of NRC Regulatory Guide 1.76 (dated April 1974)*, January 2006 (DG-1143) and the predecessor US Atomic Energy Commission (USAEC) guidance document WASH-1300, *Technical Basis for Interim Regional Tornado Criteria* **(USAEC 1974),** on which the original version of Regulatory Guide 1.76 is based:

- Tornado strike probability
- Maximum wind speed
- Translational speed

- Maximum rotational wind speed
- Radius of maximum rotational speed
- Pressure drop
- Rate of pressure drop

The tornado strike probability is determined by evaluating certain characteristics of tornadoes that have been observed within a 2-degree latitude and longitude square centered on the VEGP site. These characteristics include the Fujita-scale wind speed classification (or "F-scale") and the Pearson-scale path length and path width classification (or "P-scale"). As tornado intensity increases, so does the magnitude or the dimensions of these parameters along with the assigned numerical classification, which ranges from 0 to 5.

The 2-degree square area was assumed to be centered on the VEGP Unit 1 reactor, adjacent to the new unit footprint, and located at the following coordinates:

Latitude = 33° 08' 30" N; Longitude = 81° 45' 44" W

A searchable database of tornado occurrences by location, date, and time; starting and ending coordinates; F-scale classification; P-scale dimensions; and damage statistics has been compiled by the NCDC beginning with January 1950 **(NCDC 2006a)**. The 2-degree square area for this evaluation includes all or portions of 30 counties in Georgia and all or portions of 18 counties in South Carolina.

Through the nearly 55-year period ending April 30, 2005, the records in the database indicate that a total of 348 tornadoes or portions of a tornado path passed within the 2-degree square area centered on the VEGP site. Tornado F-scale classifications (with corresponding wind speed range) and respective frequencies of occurrence are as follows:

- F5 (wind speed > 117 m/sec) = 0
- F4 (wind speed 93 to 116 m/sec) = 1
- F3 (wind speed 70 to 92 m/sec) = 18
- F2 (wind speed 50 to 69 m/sec) = 62
- F1 (wind speed 33 to 49 m/sec) = 151
- F0 (wind speed 18 to 32 m/sec) = 116

Following the WASH-1300 methodology, the probability that a tornado will strike a particular location during any one year is given as:

$$P_S = n\ (a / A)$$

where:

P_S = mean tornado strike probability per year

n = average number of tornadoes per year in the area being considered

a = average individual tornado area

A = total area being considered (i.e., the 2-degree square area)

Based on an average occurrence of 6.29 tornadoes per year (i.e., 348 tornadoes over a 55.33-year period of record), an average individual tornado area of 0.197 sq mi (i.e., an average tornado path length of 3.3 mi and an average tornado path width of 105.3 yds), and a total area of 16,010 sq mi for the 2-degree square under consideration, the tornado strike probability (P_S) for the VEGP site area is estimated to be about 774 x 10^{-7} (about 0.0000774 per year), or a recurrence interval of once every 12,920 years.

WASH-1300 indicates that determination of the DBT characteristics is based on the premise that the probability of occurrence of a tornado that exceeds the DBT should be on the order of 10^{-7} per year per nuclear power plant. DG-1143 retains that threshold criterion.

The estimated recurrence interval for the VEGP site area exceeds this threshold; therefore, it is necessary to determine the DBT parameters listed at the beginning of this section. These parameters are able to be calculated from the area-specific database used to determine P_S. However, DG-1143 also provides DBT characteristics for three tornado intensity regions, each with a 10^{-7} probability of occurrence, that are acceptable to the agency.

As indicated in DG-1143, Figure 1, the VEGP site is adjacent to Tornado Intensity Regions I and II. The more conservative DBT parameters for Region I will be used for the design of structures, systems, and components that are important to safety that must take DBT characteristics into account. DG-1143, Table 1, provides the following DBT parameter values for Tornado Intensity Region I:

- Maximum wind speed = 300 mph
- Translational speed = 60 mph
- Maximum rotational wind speed = 240 mph
- Radius of maximum rotational speed = 150 ft
- Pressure drop = 2.0 psi
- Rate of pressure drop = 1.2 psi/sec

2.3.1.3.3 Tropical Cyclones

Tropical cyclones include not only hurricanes and tropical storms, but systems classified as tropical depressions, sub-tropical depressions, and extra-tropical storms, among others. This characterization considers all “tropical cyclones” (rather than systems classified only as hurricanes and tropical storms) because storm classifications are generally downgraded once landfall occurs and the systems weaken, although they may still result in significant rainfall events as they travel through the site region.

NOAA's Coastal Services Center (NOAA-CSC) provides a comprehensive historical database, extending from 1851 through 2004, of tropical cyclone tracks based on information compiled by the National Hurricane Center. This database indicates that a total of 102 tropical cyclone centers or storm tracks have passed within a 100-nautical mile radius of the VEGP site during this historical period **(NOAA-CSC 2005)**. Storm classifications and respective frequencies of occurrence over this 154-year period of record are as follows:

- Hurricanes – Category 3 (5), Category 2 (4), Category 1 (16)
- Tropical storms – 46
- Tropical depressions – 23
- Sub-tropical storms – 1
- Sub-tropical depressions – 2
- Extra-tropical storms – 5

Tropical cyclones within this 100-nautical-mile radius have occurred as early as May and as late as November, with the highest frequency (36 out of 102 events) recorded during September, including all classifications except sub-tropical depressions. August and October account for 21 and 20 events, respectively, indicating that 75 percent of the tropical cyclones that affect the VEGP site area occur from mid-summer to early autumn. Three of the five Category 3 hurricanes occurred in September, and the other two occurred in August.

Tropical cyclones are responsible for at least 9 separate rainfall records at 6 NWS cooperative observer network stations in the VEGP site area – six 24-hour (daily) rainfall totals and 3 monthly rainfall totals (see Table 2.3-3). In October 1990, rainfall associated with Tropical Depression Marco (along with a slow-moving cold frontal system) resulted in historical daily maximum totals of 8.19 in. at the Midville Experiment Station and 5.50 in. at the Newington 2NE Station, both located in Georgia. Two daily records were established due to Hurricane Gracie in September 1959, at the Blackville 3W (7.53 in.) and Springfield (7.10 in.) stations in South Carolina. In August 1964, a 24-hour rainfall total of 8.02 in. was recorded at the Millen 4N Station (in Georgia) due to Tropical Storm Cleo. A daily maximum total of 7.30 in. was measured at the Augusta Weather Service Office (WSO) (also in Georgia) in September 1998 during the passage of Tropical Storm Earl **(NCDC 2004, 2006b; SERCC 2006)**.

Monthly station records were established due to contributions from the following tropical cyclones: Tropical Depression Marco in October 1990 (14.82 in. at Augusta WSO and 14.67 in. at Blackville 3W), and Tropical Storm Cleo in August 1964 (13.45 in. at Millen 4N). **(NCDC 2004, 2006b)**.

2.3.1.3.4 Precipitation Extremes

Because precipitation is a point measurement, mean and extreme statistics, such as individual storm event, or daily or cumulative monthly totals typically vary from station to station. Assessing the variability of precipitation extremes over the VEGP site area, in an effort to evaluate whether the available long-term data are representative of conditions at the site, is largely dependent on station coverage.

Historical precipitation extremes (rainfall and snowfall) are presented in Table 2.3-3 for the eight nearby climatological observing stations listed in Table 2.3-1. Based on the similarity of the maximum recorded 24-hour and monthly totals among these stations and the areal distribution of these stations around the VEGP site, the data suggest that these statistics are reasonably representative of precipitation extremes that might be expected to be observed at the site.

As indicated in Section 2.3.1.3.3, most of the individual station 24-hour rainfall records (and to a lesser extent the monthly record totals) were established as a result of precipitation associated with tropical cyclones that passed within a 100-nautical-mile radius of the VEGP site.

However, the overall highest 24-hour rainfall total in the VEGP site area — 9.68 in. on April 16, 1969, at the Aiken 4NE Station in South Carolina **(NCDC 2005b)**, about 25 mi north-northeast of the VEGP site—was not associated with a low-pressure system or other well-defined synoptic-scale feature. Rather, this appears to have been an embedded, localized event in an otherwise widespread area of disturbed weather that brought precipitation to the entire East Coast **(ESSA 1969)**.

Similarly, the overall highest monthly rainfall total recorded in the VEGP site area —17.32 in. during June 1973 at the cooperative observing station in Springfield, South Carolina **(SERCC 2006; NCDC 2002c)**, 37 mi northeast of the VEGP site — represents the accumulation of 21 days of measurable precipitation during that month **(NCDC 2002c)** due to both synoptic-scale weather features (e.g., stationary frontal boundaries and stalled low-pressure areas off the Carolina coast) and more regional- to local-scale events (i.e., thunderstorms).

For the most part, when daily or monthly rainfall records were established at a given station, regardless of their cause(s), significant amounts of precipitation were usually measured at the other stations in the VEGP site area **(NCDC 2002c)**.

Although the disruptive effects of any winter storm accompanied by frozen precipitation can be significant in the Upper Coastal Plain of Georgia and South Carolina, storms that produce large measurable amounts of snow occur infrequently. With one exception, all of the 24-hour and monthly record snowfall totals listed in Table 2.3-3 were established during the storm of early February 1973, the highest 24-hour and monthly totals (17.0 in., in both cases) being recorded at the Blackville 3W Station in South Carolina, about 29 mi east-northeast of the VEGP site. Similar amounts, ranging from 14.0 to 16.0 in., were recorded at most of the other stations **(NCDC 2005b; SERCC 2006)**.

The stations with lower maximum 24-hour snowfall totals — 8.0 in. at the Augusta WSO on February 9 and 5.0 in. at Newington 2NE on February 10 (both in Georgia) **(NCDC 2005b; SERCC 2006)**, and 8.0 in. at Springfield, South Carolina, on February 11 **(SERCC 2006; NCDC 2002c)** — recorded a comparable amount of snowfall on the preceding or following day, making the 2-day totals for these stations similar to the single-day records at the other stations (except at the Newington 2NE station, the lowest of all the station records).

The record monthly snowfall total at the Millen 4N Station (15.0 in. in February 1968) represents the cumulative amount from two smaller snow events that occurred around February 8 and from February 22 to 24. A review of the daily records for the other stations indicates that except for the Augusta (Georgia) and Blackville 3W (South Carolina) stations, the data are missing for these time periods. **(NCDC 2002c)**

Estimating the design basis snow load on the roofs of safety-related structures considers two climate-related components: the weight of the 100-year return period ground-level snowpack, and the weight of the 48-hour probable maximum winter precipitation (PMWP). From a probabilistic standpoint, the estimated weight of the 100-year return period ground-level snowpack for the VEGP site area is about 10 lb/ft^2, as determined in accordance with the guidance in Section C7.0 of the ASCE-SEI design standard, *Minimum Design Loads for Buildings and Other Structures* **(ASCE 2002)**.

The 48-hour PMWP component is derived from plots of 24- and 72-hour, 10-sq mi area, monthly probable maximum precipitation (PMP) as presented in NUREG/CR-1486, *Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Extremes, United States East of the 105th Meridian,* NOAA Hydrometeorological Report No. 53, June 1980 (NUREG/CR-1486). The highest winter season (i.e., December through February) PMP values for the VEGP site area occur in December. The 48-hour PMWP value is determined by linear interpolation between the 24- and 72-hour PMP values for that month (Figures 35 and 45 of NUREG/CR-1486) and result in a value of 28.3 in. One inch of liquid water is equivalent to 5.2 lb/ft^2; therefore, the estimated weight of the 48-hour PMWP is about 147 lb/ft^2.

As Section 2.4.7 indicates, the application of these two climate-related components of design basis snow load to the roof design of safety-related structures would be described in the COL application.

2.3.1.3.5 Hail, Snowstorms, and Ice Storms

Frozen precipitation typically occurs in the form of hail, snow, sleet, and freezing rain. The frequency of occurrence of these types of weather events in the VEGP site area is based on the latest version of *The Climate Atlas of the United States* **(NCDC 2002b)**, which has been developed from observations made over the 30-year period of record from 1961 to 1990.

Though hail can occur at any time of the year and is associated with well-developed thunderstorms, it has been observed primarily during the spring and early summer months and least often during the late summer and autumn months. The Climate Atlas indicates that Burke County, Georgia, and adjacent Barnwell County, South Carolina, can expect, on average, hail with diameters 0.75 in. or greater about 1 day per year. The occurrence of hailstorms with hail greater than or equal to 1.0 in. in diameter averages less than 1 day per year in Burke County.

However, the annual mean number of days with hail 0.75 in. or greater is slightly higher in nearby Richmond and Columbia Counties, Georgia (just to the northwest of the VEGP site), and in Aiken and Edgefield Counties, South Carolina (just to the north and north-northwest of the VEGP site), ranging from 1 to 2 days per year.

NCDC cautions that hailstorm events are point observations and somewhat dependent on population density. While no hailstorms of note have been recorded in some years, multiple events have been observed in other years, including 16 events on 9 separate dates in 1998 and 8 events on 8 separate dates during 1999 in Aiken County, and 8 events on 6 separate dates during 1998 in Richmond County **(NCDC 2006b)**. Therefore, the slightly higher annual mean number of hail days may be a more representative indicator of frequency for the relatively less-populated VEGP site area.

Despite these long-term statistics, golfball-size hail (about 1.75 in. in diameter) is not a rare occurrence **(NCDC 2004, 2006b)**. However, in terms of extreme hailstorm events, the NCDC publication *Storm Data* indicates that baseball-size hail (about 2.75 in. in diameter) was observed at one location in the general VEGP site area **(NCDC 2004)** on May 21, 1964, at Hampton, South Carolina, about 43 mi southeast of the VEGP site.

Snow is infrequent in the Upper Coastal Plain of Georgia and South Carolina, where the VEGP site is located, but can occur when a source of moist air from the Atlantic Ocean or the Gulf of Mexico interacts with a very cold air mass that penetrates across the otherwise protective Appalachian mountain range in northern Georgia and northwestern South Carolina. The Climate Atlas **(NCDC 2002b)** indicates that the occurrence of snowfalls 1 in. or greater in the VEGP site area averages less than 1 day per year.

Heavy snow is a rarity. The greatest snowfall on record in the VEGP site area occurred between February 9 and 11, 1973, depending on the cooperative observing station records. Snowfall totals for the overall event typically ranged between 14 and 17 in., the highest recorded at the Blackville 3W Station on a single date (i.e., February 10), which also represents the highest cumulative monthly total for that station and for the site area. Single-day and cumulative monthly record snowfall totals were also set at nearly all of the other nearby cooperative observing stations as a result of this event. Additional details were given previously in Section 2.3.1.3.4 and Table 2.3-3.

Depending on the temperature characteristics of the air mass, snow events are often accompanied by or alternate between sleet and freezing rain as the weather system traverses the VEGP region. The Climate Atlas **(NCDC 2002b)** indicates that, on average, freezing precipitation occurs only about 1 or 2 days per year in the VEGP site area.

However, the site area appears to be in a transition zone for frequency of occurrence, with the eastern two-thirds of Aiken and Barnwell Counties and all of Allendale County (immediately to the northeast, east, and southeast in South Carolina) and the northeastern quadrant of Screven County, Georgia (just to the southeast of the VEGP site in northeastern Burke County), showing an average frequency of 3 to 5 days of freezing precipitation per year **(NCDC 2002b)**. Therefore, it is not unreasonable to expect a slightly higher annual frequency of occurrence of freezing precipitation events at the VEGP site.

Storm event records from the winters of 2000 through 2005 for the seven-county area surrounding the VEGP site note that ice accumulations of up to 1 in. have occurred, although it is typically less than this thickness **(NCDC 2006b)**.

2.3.1.3.6 Thunderstorms

Thunderstorms can occur in the VEGP site area at any time during the year. Based on a 54-year period of record, Augusta, Georgia, averages about 52 thunderstorm-days (i.e., days on which thunder is heard at an observing station) per year. On average, July has the highest monthly frequency of occurrence — about 12 days. On an annual basis, nearly 60 percent of thunderstorm-days are recorded between late spring and mid-summer (i.e., from June through August). From October through January, a thunderstorm might be expected to occur about 1 day per month. **(NCDC 2005a)**

The mean frequency of lightning strikes to earth can be estimated using a method attributed to the Electric Power Research Institute, as reported by the US Department of Agriculture Rural Utilities Service in the publication entitled Summary of Items of Engineering Interest **(DOA-RUS 1998)**. This methodology assumes a relationship between the average number of thunderstorm-days per year (T) and the number of lightning strikes to earth per square mile per year (N), where:

$$N = 0.31T$$

Based on the average number of thunderstorm-days per year at Augusta, Georgia (i.e., 52; see Table 2.3-2), the frequency of lightning strokes to earth per square mile is about 16 per year for the VEGP site area. This frequency is essentially equivalent to the mean of the 5-year (1996 to 2000) flash density for the area that includes the VEGP site, as reported by the NWS—4 to 8 flashes per square kilometer per year **(NWS 2002)**—and, therefore, a reasonable indicator.

The potential reactor area for VEGP Units 3 and 4 is represented in Figure 1-4 as an area bounded by a 775-ft-radius circle (or approximately 0.068 mi^2). Given the estimated annual average frequency of lightning strokes to earth in the VEGP site area, the frequency of lightning strokes in the reactor area can be calculated as follows:

(16 lightning strokes/mi^2/year) X (0.068 mi^2) = 1.09 lightning strokes/year

or about once each year in the reactor area.

2.3.1.4 Meteorological Data for Evaluating the Ultimate Heat Sink

Unlike the Vogtle 1 and 2 design, the AP1000 design does not use a cooling tower to release heat to the atmosphere following a Loss-of-Coolant Accident (LOCA). Instead, the AP1000 design uses a passive containment cooling system (PCS) to provide the safety-related ultimate heat sink (UHS) for the plant **(Westinghouse 2005)**. The PCS uses a high-strength steel containment vessel inside a concrete shield building. The steel containment vessel provides the heat transfer surface that removes heat from inside the containment and transfers it to the atmosphere.

Heat is removed from the containment vessel by continuous, natural circulation of air. In the event of a LOCA, a high-pressure signal activates valves, allowing water to drain by gravity from a storage tank installed on top of the shield building. An air flow path is formed between the shield building and the containment vessel to aid in the evaporation and is exhausted through a chimney at the top of the shield building **(Cummins, et al. 2003)**.

The use of the PCS in the AP1000 design is not significantly influenced by local weather conditions. Therefore, the identification of meteorological conditions that are associated with maximum evaporation and drift loss of water, as well as minimum cooling by the UHS (i.e., periods of maximum wet-bulb temperatures) is not necessary.

2.3.1.5 Design Basis Dry- and Wet-Bulb Temperatures

Long-term, engineering-related climatological data summaries, prepared by the AFCCC and the NCDC for the nearby Augusta NWS Station **(AFCCC-NCDC 1999)** are used to characterize design basis dry- and wet-bulb temperatures for the VEGP site. These characteristics include:

- Maximum ambient threshold dry-bulb (DB) temperatures at annual exceedance probabilities of 2.0 and 0.4 percent, along with the mean coincident wet-bulb (MCWB) temperatures at those values.
- Minimum ambient threshold DB temperatures at annual exceedance probabilities of 1.0 and 0.4 percent.
- Maximum ambient threshold wet-bulb temperature with an annual exceedance probability of 0.4 percent.

Based on the 24-year period of record from 1973 to 1996 for Augusta, Georgia, the maximum DB temperature with a 2.0 percent annual exceedance probability is 92°F, with a MCWB temperature of 75°F. The maximum DB temperature with a 0.4 percent annual exceedance probability is 97°F with a corresponding MCWB temperature value of 76°F. **(AFCCC-NCDC 1999)**

For the same period of record, the minimum DB temperatures with 1.0 and 0.4 percent annual exceedance probabilities are 25°F and 21°F, respectively. The maximum wet-bulb temperature with a 0.4 percent annual exceedance probability is 79°F. **(AFCCC-NCDC 1999)**

The data summaries from which the preceding statistical values were obtained do not include values that represent return intervals of 100 years. Maximum DB, minimum DB, and maximum wet-bulb temperatures corresponding to a 100-year return period were derived through linear regression using individual daily maximum and minimum DB temperatures and maximum daily wet-bulb temperatures recorded over a 30-year period (i.e., 1966 through 1995) at the Augusta NWS station **(NCDC-NREL 1993; NCDC 1997)**. Because the 100-year return period DB temperature values are extrapolated from a regression curve, no corresponding MCWB temperatures are available for this return interval.

Based on the linear regression analyses of these data sets for a 100-year return period, the maximum DB temperature is estimated to be 115°F, the minimum DB temperature is estimated to be about -8°F, and the maximum wet-bulb temperature is estimated to be 88°F.

2.3.1.6 Restrictive Dispersion Conditions

Atmospheric dispersion can be described as the horizontal and vertical transport and diffusion of pollutants released into the atmosphere. Horizontal and along-wind dispersion is controlled primarily by wind direction variation and wind speed. Section 2.3.2.2.1 addresses wind characteristics for the VEGP site vicinity based on measurements from the existing meteorological monitoring program at the VEGP site. The persistence of those wind conditions is also discussed in Section 2.3.2.2.1.

In general, lower wind speeds represent less turbulent air flow, which is restrictive to horizontal and vertical dispersion. And, although wind direction tends to be more variable under lower wind speed conditions (which increases horizontal transport), air parcels containing pollutants often re-circulate within a limited area, thereby increasing cumulative exposure.

Major air pollution episodes are usually related to the presence of stagnating high-pressure weather systems (or anti-cyclones) that influence a region with light and variable wind conditions for 4 days or more. An updated air stagnation climatology is available for the continental US based on over 50 years of observations from 1948 through 1998. Although inter-annual frequency varies, the data in Figures 1 and 2 of that report indicate that, on average, the VEGP site area can expect about 20 days per year with stagnation conditions, or about 4 cases per year with the mean duration of each case lasting about 5 days. **(Wang and Angell 1999)**

Air stagnation conditions primarily occur during an “extended” summer season that runs from May through October. This is a result of the weaker pressure and temperature gradients, and therefore weaker wind circulations, during this period (as opposed to the winter season). Based on the *Air Stagnation Climatology for the United States (1948-1998)*, Figures 17 to 67, the highest incidence is recorded in the latter half of that period between August and October, typically reaching its peak in September. As the LCD summary for Augusta, Georgia, in Table 2.3-2 indicates, this 3-month period coincides with the lowest monthly mean wind speeds during the year. Within this “extended” summer season, air stagnation is at a relative minimum during July due to the influence of the Bermuda High pressure system. **(Wang and Angell 1999)**

The mixing height (or depth) is defined as the height above the surface through which relatively vigorous vertical mixing takes place. Lower mixing heights (and wind speeds), therefore, are a relative indicator of more restrictive dispersion conditions. Holzworth (1972) reports mean seasonal and annual morning and afternoon mixing heights and wind speeds for the contiguous US based on observations over the 5-year period from 1960 to 1964. Out of the network of 62 NWS stations in the 48 contiguous US at which daily surface and upper air sounding measurements were routinely made, one station was located in Athens, Georgia, about 105 mi northwest of the VEGP site. The information in that report indicates that the results from that station should be reasonably representative of conditions at the VEGP site.

Table 2.3-4 summarizes the mean seasonal and annual morning and afternoon mixing heights and wind speeds for Athens, Georgia **(Holzworth 1972)**. From a climatological standpoint, considering all weather conditions, the lowest morning mixing heights occur in the autumn and are highest during the winter although, on average, morning mixing heights are only slightly lower in the spring and summer months than during the winter. Conversely, afternoon mixing heights reach a seasonal minimum in the winter and a maximum during the summer, as might be expected due to more intense summertime heating.

The wind speeds listed in Table 2.3-4 for Athens, Georgia, are consistent with the LCD summary for Augusta, Georgia, in Table 2.3-2 in that the lowest mean wind speeds are shown to occur during summer and autumn. This period of minimum wind speeds likewise coincides with the “extended” summer season described by Wang and Angell (1999) that is characterized by relatively higher air stagnation conditions.

2.3.2 Local Meteorology

The potential influence of the construction and operation of VEGP Units 3 and 4 are evaluated using meteorological data representative of local conditions as described below.

2.3.2.1 Data Sources

The primary sources of data used to characterize local meteorological and climatological conditions representative of the VEGP site include summaries for the first-order NWS station at

Augusta, Georgia (Bush Field) and seven other nearby cooperative network observing stations, and measurements from the existing VEGP onsite meteorological monitoring program. Table 2.3-1 identifies the offsite observing stations and provides the approximate distance and relative direction of each station to the VEGP site; their locations are shown in Figure 2.3-1. The onsite primary meteorological tower is located about 1 mi south-southwest of the Units 1 and 2 Containment Buildings and about 0.9 mi south of the proposed VEGP units as shown on Figure 1-4.

The NWS and cooperative observing station summaries were used to characterize climatological normals, period-of-record means, and extremes of temperature, rainfall, and snowfall in the vicinity of the VEGP site. In addition, first-order NWS stations also record measurements, typically on an hourly basis, of other weather elements, including winds, relative humidity, dew point, and wet-bulb temperatures, as well as other observations (e.g., fog, thunderstorms). This information was based on the following resources:

- *2004 Local Climatological Data, Annual Summary with Comparative Data for Augusta, Georgia* **(NCDC 2005a)**
- *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries* **(NCDC 2005b)**
- *Climatography of the United States, No. 81, 1971-2000, U.S. Monthly Climate Normals* **(NCDC 2002a)**
- *SERCC, Historical Climate Summaries and Normals for the Southeast* **(SERCC 2006)**
- *Cooperative Summary of the Day, TD3200, Period of Record through 2001 for the Eastern United States, Puerto Rico and the Virgin Islands* **(NCDC 2002c)**

Wind speed, wind direction, and atmospheric stability data based on the VEGP meteorological monitoring program form the basis for determining and characterizing atmospheric dispersion conditions in the vicinity of the site. These data include measurements taken over the 5-year period of record from 1998 through 2002.

2.3.2.2 Normal, Mean, and Extreme Values of Meteorological Parameters

Historical extremes of temperature, rainfall, and snowfall are listed in Table 2.3-3 for the eight NWS and cooperative observing stations in the VEGP site area. The normals, means, and extremes of the more extensive set of measurements and observations made at the Augusta NWS Station are summarized in Table 2.3-2. Finally, Table 2.3-5 compares the annual normal (i.e., 30-year average) daily maximum, minimum, and mean temperatures, as well as the normal annual rainfall and snowfall totals for these stations.

2.3.2.2.1 Wind

Average Wind Direction and Wind Speed Conditions

The distribution of wind direction and wind speed is an important consideration when characterizing the dispersion climatology of a site. Long-term average wind motions at the macro- and synoptic scales (i.e., on the order of several thousand down to several hundred kilometers) are influenced by the general circulation patterns of the atmosphere at the macro-scale and by large-scale topographic features (e.g., mountain ranges, land-water interfaces such as coastal areas). These characteristics are addressed in Section 2.3.1.2.

Site-specific or micro-scale (i.e., on the order of 2 km or less) wind conditions, while reflecting these larger-scale circulation effects, are influenced primarily by local and, to a lesser extent (generally), by meso- or regional-scale (i.e., up to about 200 km) topographic features. Wind measurements at these smaller scales are available from the existing meteorological monitoring program at the VEGP site and from data recorded at the nearby Augusta NWS Station.

Section 2.3.3 provides a summary description of the onsite meteorological monitoring program at the VEGP site. In its current configuration, wind direction and wind speed measurements are made at two levels on an instrumented 60-m tower (i.e., the lower level at 10 m and the upper level at 60 m).

Figures 2.3-2 through 2.3-6 present annual and seasonal wind rose plots (i.e., graphical distributions of the direction from which the wind is blowing and wind speeds for each of sixteen 22.5-degree compass sectors centered on north, north-northeast, northeast, etc.) for the 10-m level based on measurements at the VEGP site over the composite 5-year period from 1998 through 2002.

For the VEGP site, the wind direction distribution at the 10-m level generally follows a southwest-northeast orientation on an annual basis (see Figure 2.3-2). The prevailing wind (i.e., defined as the direction from which the wind blows most often) is from the southwest, with nearly 25 percent of the winds blowing from the southwest through west sectors. Conversely, winds from the northeast through east sectors occur about 20 percent of the time. On a seasonal basis, winds from the southwest quadrant predominate during the spring and summer months (see Figures 2.3-4 and 2.3-5). This is also the case during the winter, although westerly winds prevail and the relative frequency of west-northwest winds during this season is greater (see Figure 2.3-3) due to increased cold frontal passages. Winds from the northeast quadrant predominate during the autumn months (see Figure 2.3-6). Plots of individual monthly wind roses at the 10-m measurement level are presented in Figure 2.3-7 (Sheets 1 to 12).

Wind rose plots based on measurements at the 60-m level are shown in Figures 2.3-8 through 2.3-13. By comparison, wind direction distributions for the 60-m level are fairly similar to the 10-m level wind roses on a composite annual (see Figure 2.3-8) and seasonal basis (see

Figures 2.3-9 through 2.3-12). Plots of individual monthly wind roses at the 60-m measurement level are presented in Figure 2.3-13 (Sheets 1 to 12).

Wind information summarized in the LCD for the Augusta NWS Station (see Table 2.3-2) indicates a prevailing west-southwesterly wind direction **(NCDC 2005a)** that appears to be similar to the 10-m level wind flow at the VEGP site, at least on an annual basis (see Figure 2.3-2).

Table 2.3-6 summarizes seasonal and annual mean wind speeds based on measurements from the upper and lower levels of the existing VEGP site meteorological tower (1998–2002) and from wind instrumentation at the Augusta NWS Station (1971–2000 station normals) **(NCDC 2005a)**. The elevation of the wind instruments at the Augusta NWS Station is nominally 20 ft (about 6.1 m) **(NCDC 2005a)**, comparable to the lower (10-m) level measurements at the VEGP site.

On an annual basis, mean wind speeds at the 10- and 60-m levels are 2.5 m/sec and 4.6 m/sec, respectively, at the VEGP site. The annual mean wind speed at Augusta (i.e., 2.7 m/sec) is similar to the 10-m level at the VEGP site, differing by only 0.2 m/sec; seasonal average wind speeds at Augusta are likewise slightly higher. Seasonal mean wind speeds for both measurement levels at the VEGP site follow the same pattern discussed in Section 2.3.1.6 for Augusta and Athens, Georgia, and their relationship to the seasonal variation of relatively higher air stagnation and restrictive dispersion conditions in the site region.

The annual frequencies of calm wind conditions are 0.44 and 0.07 percent of the time for the 10-m and 60-m tower levels, respectively, at the VEGP site.

Wind Direction Persistence

Wind direction persistence is a relative indicator of the duration of atmospheric transport from a specific sector-width to a corresponding downwind sector-width that is 180 degrees opposite. Atmospheric dilution is directly proportional to the wind speed (other factors remaining constant). When combined with wind speed, a wind direction persistence/wind speed distribution further indicates the downwind sectors with relatively more or less dilution potential (i.e., higher or lower wind speeds, respectively) associated with a given transport wind direction.

Tables 2.3-7 and 2.3-8 present wind direction persistence/wind speed distributions based on measurements at the VEGP site for the 5-year period of record from 1998 through 2002. The distributions account for durations ranging from 1 to 48 hours for wind directions from 22.5-degree and 67.5-degree upwind sectors centered on each of the 16 standard compass radials (i.e., north, north-northeast, northeast, etc.). Further, the distributions are provided for wind measurements made at the lower (10-m) and the upper (60-m) tower levels, respectively.

2.3.2.2.2 Atmospheric Stability

Atmospheric stability is a relative indicator for the potential diffusion of pollutants released into the ambient air. Atmospheric stability, as discussed in this SSAR, is determined by the delta-temperature (ΔT) method as defined in Table 1 of Proposed Revision 1 to Regulatory Guide 1.23, *Meteorological Programs in Support of Nuclear Power Plants,* September 1980 (RG 1.23).

The approach classifies stability based on the temperature change with height (i.e., the difference in °C per 100 m). Stability classifications are assigned according to the following criteria:

- Extremely Unstable (Class A) — $\Delta T/\Delta Z \leq -1.9°C$
- Moderately Unstable (Class B) — $-1.9°C < \Delta T/\Delta Z \leq -1.7°C$
- Slightly Unstable (Class C) — $-1.7°C < \Delta T/\Delta Z \leq -1.5°C$
- Neutral Stability (Class D) — $-1.5°C < \Delta T/\Delta Z \leq -0.5°C$
- Slightly Stable (Class E) — $-0.5°C < \Delta T/\Delta Z \leq +1.5°C$
- Moderately Stable (Class F) — $+1.5°C < \Delta T/\Delta Z \leq +4.0°C$
- Extremely Stable (Class G) — $+4.0°C < \Delta T/\Delta Z$

The diffusion capacity is greatest for extremely unstable conditions and decreases progressively through the remaining unstable, neutral stability, and stable classifications.

During the 1998 through 2002 time period at the VEGP site, ΔT was determined from the difference between temperature measurements made at the 10-m and 60-m tower levels. Seasonal and annual frequencies of atmospheric stability class and associated 10-m level mean wind speeds for this period of record are presented in Table 2.3-9.

The data indicate a predominance of slightly stable (Class E) and neutral stability (Class D) conditions, ranging from about 50 to 60 percent of the time on a seasonal and annual basis. Extremely unstable conditions (Class A) are more frequent during the spring and summer months due to greater solar insolation. Extremely stable conditions (Class G) are most frequent during the fall and winter months, owing in part to increased radiational cooling at night.

Joint frequency distributions (JFDs) of wind speed and wind direction by atmospheric stability class and for all stability classes combined for the 10-m and 60-m wind measurement levels at the VEGP site are presented in Tables 2.3-10 and 2.3-11, respectively, for the 5-year period of record from 1998 through 2002. The 10-m level JFDs are used to evaluate short-term dispersion estimates for accidental atmospheric releases (see Section 2.3.4) and long-term diffusion estimates of routine releases (see Section 2.3.5).

2.3.2.2.3 Temperature

Extreme maximum temperatures recorded in the vicinity of the VEGP site have ranged from 105°F to 110°F, with the highest reading observed at the Newington 2NE Station on July 13, 1980. The station record high temperature for the Midville Experiment Station (i.e., 105°F) has been reached on four separate occasions. As Table 2.3-3 shows, individual station extreme maximum temperature records were set at multiple locations on the same or adjacent dates (i.e., Waynesboro 2NE and Millen 4N; Augusta, Midville Experiment Station, and Aiken 4NE; and Waynesboro 2NE, Midville Experiment Station, and Newington 2NE) **(NCDC 2005b; SERCC 2006)**.

Extreme minimum temperatures in the vicinity of the VEGP site have ranged from 0°F to -4°F, with the lowest reading on record observed at the Aiken 4NE Station on January 21, 1985, the same date on which the record low temperature was set at the seven other nearby stations **(NCDC 2005b; SERCC 2006)**.

The extreme maximum and minimum temperature data indicate that synoptic-scale conditions responsible for periods of record-setting excessive heat as well as significant cold air outbreaks tend to affect the overall VEGP site area. The similarity of the respective extremes suggests that these statistics are reasonably representative of the temperature extremes that might be expected to be observed at the VEGP site.

Daily mean temperatures (which are based on the average of the daily mean maximum and minimum temperature values) for these stations are similar, ranging from 63.1°F at Waynesboro 2NE to 65.0°F at the Midville Experiment Station **(NCDC 2002a)**. Likewise, the diurnal (day-to-night) temperature ranges, as indicated by the differences between the daily mean maximum and minimum temperatures, are fairly comparable, ranging from 23.7°F at Newington 2NE to 26.3°F at Aiken 4NE **(NCDC 2002a)**.

2.3.2.2.4 Water Vapor

Based on a 49-year period of record, the LCD summary for the Augusta, Georgia NWS Station (see Table 2.3-2) indicates that the mean annual wet-bulb temperature is 56.7°F, with a seasonal maximum during the summer months (June through August) and a seasonal minimum during the winter months (December through February). The highest monthly mean wet-bulb temperature is 72.7°F in July (only slightly less during August); the lowest monthly mean value (40.3°F) occurs during January. **(NCDC 2005a)** Wet-bulb temperature characteristics are addressed in Section 2.3.1.5 from a design-basis standpoint.

The LCD summary shows a mean annual dew point temperature of 51.9°F, also reaching its seasonal maximum and minimum during the summer and winter, respectively. The highest monthly mean dew point temperature is 69.7°F in July; again, only slightly less during August.

The lowest monthly mean dew point temperature (34.4°F) occurs during January. **(NCDC 2005a)**

The 30-year normal daily relative humidity averages 72 percent on an annual basis, typically reaching its diurnal maximum in the early morning (around 0700 hours) and its diurnal minimum during the early afternoon (around 1300 hours). There is less variability in this day-to-night pattern with the passage of weather systems, persistent cloud cover, and precipitation. Nevertheless, this diurnal pattern is evident throughout the year. The LCD summary shows that average early morning relative humidity levels exceed 90 percent during August, September, and October. **(NCDC 2005a)**

2.3.2.2.5 Precipitation

With the exception of the Aiken 4NE Station, normal annual rainfall totals are similar for the seven other nearby observing stations listed in Table 2.3-5, differing by only about 4 in. (or less than 10 percent) and ranging from 43.85 to 47.81 in. The current 30-year average for the Aiken 4NE Station is somewhat higher at 52.43 in. Snowfall is an infrequent occurrence, as discussed in Section 2.3.1, with normal annual totals of only 0.1 to 1.4 in. **(NCDC 2002a, 2005b; SERCC 2006)**.

2.3.2.2.6 Fog

The closest station to the VEGP site at which observations of fog are made and routinely recorded is the Augusta NWS Station about 20 mi to the northwest. The 2004 LCD summary for this station (Table 2.3-2) indicates an average of 35.1 days per year of heavy fog conditions based on a 54-year period of record. The NWS defines heavy fog as fog that reduces visibility to 1/4 mi or less.

The frequency of fog conditions at the VEGP site would be expected to be similar to that of Augusta because of their proximity to one another and because of the similarity of topographic features at both locations (i.e., gently rolling terrain, adjacent to the Savannah River, and location within that broad river valley).

2.3.2.3 Potential Influence of the Plant and Related Facilities on Meteorology

The dimensions and operating characteristics of the proposed VEGP Units 3 and 4 and existing VEGP Units 1 and 2 facilities and the associated paved, concrete, or other improved surfaces are considered to be insufficient to generate discernible, long-term effects to local- or micro-scale meteorological conditions.

Wind flow may be altered in areas immediately adjacent to and downwind of larger site structures. However, these effects will likely dissipate within ten structure heights downwind of the intervening structure(s). Similarly, while ambient temperatures immediately above any improved surfaces could increase, these temperature effects will be too limited in their vertical profile and horizontal extent to alter local- or regional-scale ambient temperature patterns.

Units 1 and 2 at the VEGP site use two 550-ft-high natural-draft cooling towers as a means of heat dissipation. Depending on local meteorological conditions, plume rise ranges from 500 to 1,000 ft above those 550-ft-high towers. Because of the elevated release point and plume rise, there is minimal effect on local meteorology or the plant.

Two 600-ft-high natural-draft cooling towers will provide cooling for the proposed VEGP Units 3 and 4. Because the release height of the thermal/water vapor plumes from these cooling towers will be even higher than that of the existing VEGP cooling towers, minimal effect on local meteorology or the plant will be expected.

2.3.2.4 Current and Projected Site Air Quality

The VEGP site is located within the Augusta (Georgia) – Aiken (South Carolina) Interstate Air Quality Control Region (40 CFR 81.114). The counties within this region are designated as being in attainment or unclassified for all criteria air pollutants (40 CFR 81.311; 40 CFR 81.341). Attainment areas are areas where the ambient air quality levels are better than the EPA-promulgated National Ambient Air Quality Standards (NAAQS). Criteria pollutants are those for which NAAQS have been established: sulfur dioxide, particulate matter (i.e., PM_{10} and $PM_{2.5}$ – particles with nominal aerodynamic diameters less than or equal to 10.0 and 2.5 micons, respectively), carbon monoxide, nitrogen dioxide, ozone, and lead (40 CFR Part 50).

Four pristine areas in the States of Georgia and South Carolina are designated as “Mandatory Class I Federal Areas Where Visibility is an Important Value.” They include the Cohutta Wilderness Area, the Okefenokee Wilderness Area, and the Wolf Island Wilderness Area in Georgia (40 CFR 81.408), and the Cape Romain Wilderness Area in South Carolina (40 CFR 81.426). The two closest of these Class I areas are both about 130 mi away from the VEGP site—the Wolf Island Wilderness Area to the south-southeast and the Cape Romain Wilderness Area to the east-southeast.

The new nuclear steam supply system and other related radiological systems are not sources of criteria pollutants or other air toxics. Supporting equipment (e.g., diesel generators, fire pump engines, auxiliary boilers), emergency station-blackout generators, and other non-radiological emission-generating sources (e.g., storage tanks and related equipment) or activities will not be expected to be a significant source of criteria pollutant emissions.

Emergency equipment will only be operated on an intermittent test or emergency-use basis. Therefore, these emission sources will not be expected to significantly impact ambient air quality levels in the vicinity of the VEGP site, nor will they be anticipated to be a significant factor in the design and operating bases of proposed VEGP Units 3 and 4. Likewise, because of the relatively long distance of separation from the VEGP site, visibility at any of these Class I

Federal Areas will not be expected to be significantly impacted by project construction and facility operations.

Nevertheless, these non-radiological emission sources will likely be regulated by the Georgia Department of Natural Resources (DNR) under the Georgia Rules for Air Quality Control (Chapter 391-3-1) and permitted under the State's Title V Operating Permit Program implemented by the Georgia DNR pursuant to 40 CFR Part 70 either as a separate facility or via a revision to the then current Title V Operating Permit for the existing VEGP site.

2.3.2.5 Topographic Description

The VEGP site (approximately 3,169 acres) is located in Burke County, Georgia, along (west of) the Savannah River. Topographic features within a 5-mi radius of the VEGP site are shown in Figure 2.3-14. Terrain elevation profiles along each of the 16 standard 22.5-degree compass radials out to a distance of 50 mi from the VEGP site are illustrated in Figure 2.3-15 (Sheets 1 through 4).

These profiles indicate that the terrain in the VEGP site area is flat to gently rolling. The only other nearby topographic feature of note is the Savannah River, located adjacent to the VEGP site; the broad river valley represents a depression running northwest to southeast.

2.3.3 Onsite Meteorological Measurements Program

2.3.3.1 Onsite Meteorological Measurements Program

SNC plans to use measurement data from the VEGP onsite meteorological monitoring program to support operation of the proposed VEGP Units 3 and 4.

2.3.3.2 General Program Description

The VEGP onsite meteorological measurements program commenced operation in April 1972. Instruments for measuring pertinent meteorological parameters were installed on a 45-m tower located in a cleared area at site coordinates N 3260 and E 8040. This location is about 3,840 ft (1,170 m) south of the 775-ft-radius circle that encloses the VEGP Units 3 and 4 power block area (see Figure 1-4 for general location). The base of the tower is at approximately plant grade.

The onsite meteorological measurements program and equipment were updated in the first quarter of 1984 to meet the intent of NUREG-0654 (*Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,* FEMA-REP-1, Revision 1, November 1980). A new meteorological data collection center (MDCC) included a 60-m tower located at site coordinates N 3100 and E 7940 with permanent instrumentation at the 10- and 60-m elevations. The 60-m tower is located about 3,960 ft (1,207 m) south of the 775-ft-radius circle that encloses the VEGP Units 3 and 4 power block area (see Figure 1-4 for general location). A 2-kVA uninterruptible power supply was also installed to prevent the loss of meteorological data collection in the event that offsite power is interrupted.

The 60-m tower serves as the primary source of site meteorological data. The 45-m tower is now used as a backup for periods of equipment failure on the 60-m tower and consists of wind speed, wind direction, and ambient temperature measurements at the 10-m elevation only. Table 2.3-12 presents instrument descriptions for the backup and primary meteorological monitoring systems. Measurement system accuracies are in conformance with RG 1.23.

The instruments are monitored at least once a week by SNC personnel. Preventive maintenance is performed by SNC personnel in accordance with the instrument manuals and is intended to maintain 90 percent data recovery.

Data collection for the MDCC consists of continuous strip chart recorders and digital data collection equipment, both located in the meteorological tower equipment building. These data are transmitted to the power block via a microwave communication link. This microwave link provides instrument data to the Unit 1 Control Room, Technical Support Center, and Emergency Operations Facility via the Unit 1 plant computer. Additionally, the microwave link provides for telephone communication to the tower equipment building and for MDCC trouble alarms. The collected data are compiled in accordance with RG 1.23 and are summarized and edited to provide averages representative of each hour of measurements.

The annual and/or seasonal summaries of onsite meteorological data presented in this report are based on hourly-averaged measurements from instrumentation mounted on the primary tower taken over the 5-year period of record from 1998 through 2002. These data were used to determine the wind roses and joint frequency distributions of wind speed and wind direction by atmospheric stability class presented and discussed in Section 2.3.2.

A year-by-year summary of the percent data recoveries for each parameter is shown in Table 2.3-13. Composite data recoveries of 94 percent or greater were achieved in each of those 5 years for the dispersion modeling-related parameters of wind speed and wind direction from the 10-m and 60-m levels, and vertical stability based on the delta-temperature between the 60-m and 10-m levels. The only parameters with annual data recoveries less than the 90 percent target recovery level are dew point temperature (i.e., 89.6 percent) and rainfall (i.e., 78.8 percent) during 2002.

2.3.3.3 Location, Elevation, and Exposure of Instruments

The general location of both the primary and backup meteorological towers is shown in Figure 1-4. The towers are located near one another, as discussed later, and the area indicated on Figure 1-4 for the meteorological tower encloses the locations of both towers.

The nearest major structures will be the proposed VEGP Units 3 and 4 reactors and the proposed natural-draft cooling towers, which will be located, respectively, about 4,645 ft and 2,990 ft to the north of the primary tower. RG 1.23 indicates that a meteorological tower located at 10-building-heights horizontal distance downwind will not have adverse building wake effects exerted by the structure. Since the height of the proposed AP1000 units will be about 234 ft above grade, the zone of turbulent flow created by the reactor buildings will be limited to about 2,340 ft (or 10 building heights) downwind. Thus, the proposed reactors will not be expected to adversely affect the measurements taken at the primary tower.

The 10-building-height distance of separation guidance is usually applied to square- or rectangular-shaped structures or objects. A round structure will produce a downwind wake zone that is shorter than a square or rectangular structure or object. The downwind region of adverse influence of a hyperbolically-shaped, natural-draft cooling tower is estimated to be about five times the width of the tower at the top of the structure **(EPA 1981)**.

The preliminary design indicates that the proposed natural-draft cooling towers will be about 600 ft high, with a base diameter of 550 ft, and a diameter of 330 ft at the top. Based on the EPA guidance for this type of structure and the diameter at its top, the outermost boundary of influence that will be exerted by the proposed cooling towers is estimated to be about 1,650 ft. This distance is much shorter than the physical separation of the proposed cooling towers from the primary meteorological tower (i.e., 2,990 ft). Therefore, the proposed natural-draft cooling towers will not be expected to adversely affect measurements made at the primary meteorological tower. Similarly, minor structures in the vicinity of the primary meteorological tower have been evaluated as having no adverse effect on the measurements taken at that tower.

The backup meteorological tower is located about 620 ft to the north-northeast of the primary tower; therefore, it will also be located beyond the wake influence zones induced by the proposed reactors and natural-draft cooling towers.

2.3.4 Short-Term (Accident) Diffusion Estimates

2.3.4.1 Basis

To evaluate potential health effects for Westinghouse AP1000 design-basis accidents, a hypothetical accident is postulated to predict upper-limit concentrations and doses that might occur in the event of a containment release to the atmosphere.

Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Revision 2, April 1998 (RG 4.7), states that for site approval, each applicant should collect at least 1 year of meteorological information that is representative of the site conditions for calculating radiation doses resulting from the release of fission products as a consequence of a postulated accident. Site-specific meteorological data covering the 5-year period of record from 1998 through 2002 (see Section 2.3.2.2.2) have been used to quantitatively evaluate such a hypothetical accident at the VEGP site. Onsite data provide representative measurements of local dispersion conditions appropriate to the VEGP site and a 5-year period is considered to be reasonably representative of long-term conditions.

According to 10 CFR Part 100, it is necessary to consider the doses for various time periods immediately following the onset of a postulated containment release at the exclusion distance and for the duration of exposure for the low population zone and population center distances. The relative air concentrations (χ/Qs) are estimated for various time periods ranging from 2 hours to 30 days.

Meteorological data have been used to determine various postulated accident conditions as specified in Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, Revision 1, November 1982 (Re-issued February 1983) (RG 1.145). Compared to an elevated release, a ground-level release usually results in higher ground-level concentrations at downwind receptors due to less dilution from shorter traveling distances. Since the ground-level release scenario provides a bounding case, elevated releases are not considered in this ESP application.

The NRC-sponsored PAVAN computer code (NUREG/CR-2858, *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations*, PNL-4413, November 1982 [NUREG/CR-2858]) has been used to estimate ground-level χ/Qs at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) for potential accidental releases of radioactive material to the atmosphere. Such an assessment is required by 10 CFR Part 100 and Appendix E of 10 CFR Part 50.

As discussed in Section 2.1.1.3, the EAB for VEGP Units 3 and 4 is the same as the exclusion area for the existing VEGP units. For the purposes of determining χ/Qs and subsequent radiation dose analyses, an effective EAB, hereafter referred to as the Dose Calculation EAB, was developed for the proposed units. The AP1000 units will be located within the power block area, shown in Figure 1-4, which is the perimeter of a 775-ft-radius circle with the centroid at a point between the two AP1000 units. The Dose Calculation EAB is a circle that extends 1/2 mi beyond the power block area (i.e., a circle with a 3,415-ft radius with its centroid at the centroid of the power block circle). The Dose Calculation EAB is completely within the actual plant EAB and, thus, the χ/Qs and the subsequent radiation doses are conservatively higher.

The PAVAN program implements the guidance provided in RG 1.145. Mainly, the code computes χ/Qs at the EAB and LPZ for each combination of wind speed and atmospheric stability class for each of 16 downwind direction sectors (i.e., north, north-northeast, northeast, etc.). The χ/Q values calculated for each direction sector are then ranked in descending order, and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speeds and stabilities for the complementary upwind direction sector. The

χ/Q value that is equaled or exceeded 0.5 percent of the total time becomes the maximum sector-dependent χ/Q value.

The χ/Q values calculated above are also ranked independently of wind direction into a cumulative frequency distribution for the entire site. The PAVAN program then selects the χ/Qs that are equaled or exceeded 5 percent of the total time.

The larger of the two values (i.e., the maximum sector-dependent 0.5 percent χ/Q or the overall site 5 percent χ/Q value) is used to represent the χ/Q value for a 0- to 2-hour time period. To determine χ/Qs for longer time periods, the program calculates an annual average χ/Q value using the procedure described in Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors*, Revision 1, July 1977 (RG 1.111). The program then uses logarithmic interpolation between the 0- to 2-hour χ/Qs for each sector and the corresponding annual average χ/Qs to calculate the values for intermediate time periods (i.e., 8 hours, 16 hours, 72 hours, and 624 hours). As suggested in NUREG/CR-2858, each of the sector-specific 0- to 2-hour χ/Qs provided in the PAVAN output file has been examined for “reasonability” by comparing them with the ordered χ/Qs also presented in the model output.

The PAVAN model has been configured to calculate offsite χ/Q values assuming both wake-credit allowed and wake-credit not allowed. The entire Dose Calculation EAB is located beyond the wake influence zone induced by the Reactor Building. And, because the LPZ is located farther away from the plant site than the Dose Calculation EAB (i.e., a 2-mi-radius circle centered at the midpoint of the existing reactors bounds the LPZ), the “wake-credit not allowed” scenario of the PAVAN results has been used for the χ/Q analyses at both the Dose Calculation EAB and the LPZ.

The PAVAN model input data are presented below:

- Meteorological data: 5-year (January 1, 1998 to December 31, 2002) composite onsite JFD of wind speed, wind direction, and atmospheric stability.
- Type of release: Ground-level.
- Wind sensor height: 10 m.
- Vertical temperature difference: (10 m-60 m).
- Number of wind speed categories: 11.
- Release height: 10 m (default height).
- Distances from release point to Dose Calculation EAB: 800 m, for all downwind sectors.
- Distances from release point to LPZ: 2,304 m, for all downwind sectors.

The PAVAN model uses building cross-sectional area and containment height to estimate wake-related χ/Q values. Since the Dose Calculation EAB and the LPZ are both located beyond the building wake influence zone, these two input parameters have no effect in calculating the non-wake χ/Q values.

To be conservative, the 1/2 mi (or approximately 800 m) distance between the VEGP Units 3 and 4 power block area circle and the Dose Calculation EAB has been entered as input for each downwind sector to calculate the χ/Q values at the Dose Calculation EAB. Similarly, the shortest distance from the proposed VEGP Unit 4 reactor to the LPZ has been entered as input to calculate the χ/Q values at the LPZ. The center of the VEGP Units 3 and 4 power block area will be located about 700 m to the west of the midpoint of the existing VEGP reactors. The proposed VEGP Unit 4 reactor will be located about 235 m west of the proposed VEGP Unit 3 reactor. Therefore, with respect to the proposed new units, the shortest distance between any of the new reactors and the LPZ will be the distance between proposed VEGP Unit 4 and the LPZ (i.e., 2,304 m [or about 1.4 mi]).

2.3.4.2 PAVAN Modeling Results

As presented in Table 2.3-14, the maximum 0- to 2-hour, 0.5 percentile, direction-dependent χ/Q value (3.11×10^{-4} sec/m^3) is greater than the corresponding 5 percentile overall site χ/Q value (3.00×10^{-4} sec/m^3) at the Dose Calculation EAB. Therefore, the direction-dependent 0.5 percentile χ/Qs should be used as the proper χ/Qs at the Dose Calculation EAB.

Similarly, Table 2.3-15 shows that the maximum 0- to 2-hour, 0.5 percentile, direction-dependent χ/Q value (1.11×10^{-4} sec/m^3) is greater than the corresponding 5 percentile overall site χ/Q value (1.10×10^{-4} sec/m^3) at the LPZ. Therefore, the direction-dependent 0.5 percentile χ/Qs should be used as the proper χ/Qs at the LPZ.

The maximum χ/Qs presented in Tables 2.3-14 and 2.3-15 for the Dose Calculation EAB and the LPZ, respectively, are summarized below for the 0- to 2-hour time period, the annual average time period, and other intermediate time intervals evaluated by the PAVAN model.

Summary of PAVAN χ/Q Results (0.5% Limiting Case), 1998–2002 Meteorological Data

Source Location	Receptor Location	0-2 hr (Dir, Dist)	0-8 hr (Dir, Dist)	8-24 hr (Dir, Dist)	1-4 days (Dir, Dist)	4-30 days (Dir, Dist)	Annual (Dir, Dist)
ESP PBAC[a]	Dose Calculation EAB	3.11E-04 (NE, 800 m)	2.18E-04 (NE, 800 m)	1.83E-04 (NE, 800 m)	1.25E-04 (NE, 800 m)	7.18E-05 (NE, 800 m)	3.66E-05 (NE, 800 m)
ESP PBAC[a]	LPZ	1.11E-04 (E, 2304 m) [b]	6.25E-05 (ENE, 2304 m)	4.70E-05 (ENE, 2304 m)	2.53E-05 (ENE, 2304 m)	1.04E-05 (ENE, 2304 m) (NE, 2304 m)	3.54E-06 (NE, 2304 m)

Notes:
a - PBAC = Power Block Area Circle
b - The 0-2 hour χ/Q values are reported here for reference only (not required based on RG 1.145).

2.3.5 Long-Term (Routine) Diffusion Estimates

2.3.5.1 Basis

The NRC-sponsored XOQDOQ computer program (NUREG/CR-2919, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations*, PNL-4380, September 1982 [NUREG/CR-2919]) was used to estimate χ/Q values due to routine releases of gaseous effluents to the atmosphere. The XOQDOQ computer code has the primary function of calculating annual average χ/Q values and annual average relative deposition (D/Q) values at receptors of interest (e.g., the Dose Calculation EAB and the LPZ boundaries, the nearest milk cow, residence, garden, meat animal). χ/Q and D/Q values due to intermittent releases, which occur during routine operation, may also be evaluated using the XOQDOQ model.

The XOQDOQ dispersion model implements the assumptions outlined in RG 1.111. The program assumes that the material released to the atmosphere follows a Gaussian distribution around the plume centerline. In estimating concentrations for longer time periods, the Gaussian distribution is assumed to be evenly distributed within a given directional sector. A straight-line trajectory is assumed between the release point and all receptors.

The following input data and assumptions have been used in the XOQDOQ modeling analysis:

- Meteorological Data: 5-year (January 1, 1998 to December 31, 2002) composite onsite JFD of wind speed, wind direction, and atmospheric stability.
- Type of release: Ground-level.
- Wind sensor height: 10 m.
- Vertical temperature difference: (10 m – 60 m).
- Number of wind speed categories: 11.
- Release height: 10 m (default height).
- Minimum building cross-sectional area: 2,926 m^2.
- Containment structure height: 65.6 m.
- Distances from the release point to the nearest residence, nearest site boundary, vegetable garden, and meat animal.

The AP1000 reactor design has been used to calculate the minimum building cross-sectional area as called for in NUREG/CR-2919 for evaluating building downwash effects on dispersion. The reactor building is a tapered-shape structure of smaller area at the top. Therefore, based on the cross-sectional area of the reactor structure (i.e., 2,926 m^2) and assuming the entire structure is rectangular, the equivalent structural height is calculated to be 65.6 m.

Distances from the midpoint between the VEGP Unit 1 and Unit 2 reactors to various receptors of interest (i.e., nearest residence, meat animal, site boundary, and vegetable garden) for each directional sector are provided in AREOR (2004). The shortest distances from any point on the VEGP Units 3 and 4 power block area circle (775-ft radius) to these same receptors of interest have been re-calculated for each directional sector. The results are presented in Table 2.3-16.

2.3.5.2 XOQDOQ Modeling Results

Table 2.3-17 summarizes the maximum relative concentration and relative deposition (i.e., χ/Q and D/Q values predicted by the XOQDOQ model for identified sensitive receptors in the vicinity of the VEGP site due to routine releases of gaseous effluents. The listed maximum χ/Q values reflect several plume depletion scenarios that account for radioactive decay (i.e., no decay, and the default half-life decay periods of 2.26 and 8 days).

The overall maximum annual average χ/Q value (with no decay) is 5.4 x 10^{-6} sec/m^3 and occurs at the Dose Calculation EAB at a distance of 0.5 mi to the northeast of the VEGP site. The maximum annual average χ/Q values (along with the direction and distance of the receptor locations relative to the VEGP site) for the other sensitive receptor types are:

- 2.5 x 10^{-6} sec/m^3 for the nearest residence occurring in the west-southwest sector at a distance of 0.67 mi.
- 3.3 x 10^{-7} sec/m^3 for the nearest vegetable garden occurring in the west-southwest sector at a distance of 2.66 mi.
- 6.4 x 10^{-7} sec/m^3 for the nearest meat animal occurring in the northwest sector at a distance of 1.49 mi.

Finally, Table 2.3-18 summarizes annual average χ/Q values (for no decay and the default half-life radioactive decay periods of 2.26 and 8 days) and D/Q values at the XOQDOQ model's 22 standard radial distances between 0.25 and 50 mi and for the model's 10 distance-segment boundaries between 0.5 and 50 mi downwind. Although the model was used to predict relative concentration and relative deposition values at the distances and for the distance-segments indicated above, along each of the 16 standard direction radials (i.e., separated by 22.5 degrees), only the results along the northeast radial are presented in Table 2.3-18 because those values represent the highest χ/Q and D/Q values from among all the direction radials modeled.

Table 2.3-1 NWS and Cooperative Observing Stations Near the VEGP Site

Station [a]	State	County	Approximate Distance (miles)	Direction Relative to Site	Elevation (feet)
Waynesboro 2NE	GA	Burke	16	WSW	270
Augusta WSO (Bush Field)	GA	Richmond	20	NW	132
Millen 4N	GA	Jenkins	22	SSW	195
Midville Experiment Station	GA	Burke	32	SW	280
Newington 2NE	GA	Screven	41	SSE	209
Aiken 4NE	SC	Aiken	25	NNE	502
Blackville 3W	SC	Barnwell	29	ENE	300
Springfield	SC	Orangeburg	37	NE	324

Notes:

a - Numeric and letter designators following a station name (e.g., Waynesboro 2NE) indicate the station's approximate distance in miles (e.g., 2) and direction (e.g.., northeast) relative to the place name (e.g.., Waynesboro).

Table 2.3-2 Local Climatological Data Summary for Augusta, Georgia

NORMALS, MEANS, AND EXTREMES

AUGUSTA, GA (AGS)

LATITUDE: 33° 22′ 11″ N | LONGITUDE: 81° 57′ 53″ W | ELEVATION (FT): GRND: 160 BARO: 163 | TIME ZONE: EASTERN (UTC + 5) | WBAN: 03820

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	56.5	61.3	69.2	76.7	83.9	89.6	92.0	90.2	85.3	76.5	67.8	59.1	75.7
	MEAN DAILY MAXIMUM	48	56.4	60.6	68.3	76.8	84.0	89.4	91.9	90.6	85.6	76.9	68.3	59.1	75.7
	HIGHEST DAILY MAXIMUM	54	82	86	89	96	99	105	107	108	101	97	90	82	108
	YEAR OF OCCURRENCE		2002	1962	1995	1986	2000	1952	1980	1983	1999	1954	1961	1998	AUG 1983
	MEAN OF EXTREME MAXS.	56	74.4	76.0	80.7	88.8	93.4	98.1	99.0	97.9	94.5	88.3	81.5	76.1	87.4
	NORMAL DAILY MINIMUM	30	33.1	35.5	42.5	48.1	57.2	65.4	69.6	68.4	62.4	49.6	40.9	34.7	50.6
	MEAN DAILY MINIMUM	48	32.7	34.7	40.4	48.9	58.0	66.0	70.1	69.1	63.3	50.7	41.5	34.3	50.8
	LOWEST DAILY MINIMUM	54	-1	0	0	26	35	47	55	52	36	22	15	5	-1
	YEAR OF OCCURRENCE		1985	1998	1998	1982	1971	1984	1951	2004	1967	1952	1970	1981	JAN 1985
	MEAN OF EXTREME MINS.	56	16.6	19.0	25.0	33.4	43.5	54.7	62.5	60.4	49.7	34.4	24.9	18.5	36.9
	NORMAL DRY BULB	30	44.8	48.4	55.9	62.4	70.5	77.5	80.8	79.3	73.8	63.1	54.4	46.9	63.1
	MEAN DRY BULB	56	45.2	48.4	55.3	63.0	71.2	77.9	81.0	80.1	74.6	64.1	54.5	46.9	63.5
	MEAN WET BULB	49	40.3	42.8	48.4	55.5	63.4	69.8	72.7	72.3	67.4	57.4	48.5	41.7	56.7
	MEAN DEW POINT	49	34.4	36.0	41.5	49.4	58.9	66.0	69.7	69.4	64.3	53.4	43.2	36.1	51.9
	NORMAL NO. DAYS WITH:														
	MAXIMUM ≥ 90°	30	0.0	0.0	0.0	0.6	5.9	16.0	23.5	19.4	9.4	0.6	0.0	0.0	75.4
	MAXIMUM ≤ 32°	30	0.4	0.2	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7
	MINIMUM ≤ 32°	30	15.0	11.5	4.6	0.9	0.0	0.0	0.0	0.0	0.0	0.6	6.5	13.1	52.2
	MINIMUM ≤ 0°	30	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	617	469	301	129	21	1	0	0	5	118	317	547	2525
	NORMAL COOLING DEG. DAYS	30	1	2	15	52	191	385	506	459	285	74	15	1	1986
RH	NORMAL (PERCENT)	30	70	67	66	66	70	72	74	77	77	75	74	72	72
	HOUR 01 LST	30	80	77	77	80	86	87	88	91	90	89	86	82	84
	HOUR 07 LST	30	84	84	85	86	87	87	89	92	92	91	89	85	88
	HOUR 13 LST	30	55	50	48	45	48	52	54	56	55	50	51	54	52
	HOUR 19 LST	30	68	61	57	55	60	63	67	72	77	78	74	71	67
S	PERCENT POSSIBLE SUNSHINE														
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG(VISBY≤1/4 MI)	54	3.5	2.7	2.1	2.5	2.5	1.4	1.6	3.1	3.8	3.9	4.0	4.0	35.1
	THUNDERSTORMS	54	0.9	1.8	2.7	3.6	6.0	9.4	11.9	9.3	3.4	1.3	0.8	0.7	51.8
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)	1			7.2		3.2	4.0	5.6	4.8		5.6		4.0	
	MIDNIGHT-MIDNIGHT (OKTAS)	1			6.4		4.0	4.0	4.8	4.0					
	MEAN NO. DAYS WITH:														
	CLEAR	1	2.0	2.0	9.0		14.0	7.0	2.0	6.0	3.0	7.0	5.0	10.0	
	PARTLY CLOUDY	1		2.0	1.0		2.0	8.0	2.0	2.0	2.0	4.0	1.0	1.0	
	CLOUDY	1	2.5	3.0	12.0		3.0	4.0		6.0	7.0	3.0	1.0	7.0	
PR	MEAN STATION PRESSURE(IN)	31	29.97	29.93	29.89	29.86	29.83	29.84	29.87	29.88	29.89	29.93	29.96	29.98	29.90
	MEAN SEA-LEVEL PRES. (IN)	47	30.14	30.09	30.04	30.02	30.00	29.99	30.03	30.01	30.04	30.08	30.11	30.15	30.06
WINDS	MEAN SPEED (MPH)	28	6.7	7.1	7.4	6.9	6.1	5.7	5.6	5.0	5.3	5.2	5.5	6.2	6.1
	PREVAIL.DIR(TENS OF DEGS)	29	27	29	29	18	14	14	24	14	04	04	29	29	24
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	10	40	37	40	37	49	45	36	38	36	38	38	35	49
	DIR. (TENS OF DEGS)		26	30	29	28	23	34	21	01	02	34	18	28	23
	YEAR OF OCCURRENCE		1997	2003	1999	2001	2004	1998	1995	2002	1997	1995	2001	2000	MAY 2004
	MAXIMUM 5-SECOND:														
	SPEED (MPH)	10	54	45	51	55	74	53	47	49	45	52	49	43	74
	DIR. (TENS OF DEGS)		25	31	29	34	23	33	21	01	01	33	03	28	23
	YEAR OF OCCURRENCE		1997	2003	1999	1997	2004	1998	1998	2002	1997	1995	1995	2000	MAY 2004
PRECIPITATION	NORMAL (IN)	30	4.50	4.11	4.61	2.94	3.07	4.19	4.07	4.48	3.59	3.20	2.68	3.14	44.58
	MAXIMUM MONTHLY (IN)	54	8.91	7.67	11.92	8.43	9.61	10.57	11.43	11.34	9.51	14.82	7.76	8.65	14.82
	YEAR OF OCCURRENCE		1987	1961	1980	1961	1979	2004	1967	1986	1975	1990	1985	1981	OCT 1990
	MINIMUM MONTHLY (IN)	54	0.75	0.69	0.88	0.60	0.36	0.68	1.02	0.65	0.31	T	0.09	0.32	T
	YEAR OF OCCURRENCE		1981	1968	1968	1970	2000	1984	1987	1980	1984	1953	1960	1955	OCT 1953
	MAXIMUM IN 24 HOURS (IN)	54	3.61	3.69	5.31	3.96	4.44	5.08	3.71	5.98	7.30	8.57	3.82	3.12	8.57
	YEAR OF OCCURRENCE		1960	1985	1967	1955	1981	1981	1979	1964	1998	1990	1985	1970	OCT 1990
	NORMAL NO. DAYS WITH:														
	PRECIPITATION ≥ 0.01	30	11.0	8.7	9.8	7.4	9.0	10.1	11.2	10.9	7.8	6.2	7.2	9.5	108.8
	PRECIPITATION ≥ 1.00	30	1.2	1.2	1.3	0.8	0.8	1.4	1.1	1.4	0.9	1.0	0.8	0.7	12.6
SNOWFALL	NORMAL (IN)	30	0.3	1.0	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4
	MAXIMUM MONTHLY (IN)	50	2.6	14.0	1.1	T	0.0	T	0.0	0.0	0.0	0.0	T	1.0	14.0
	YEAR OF OCCURRENCE		1992	1973	1980	1992		1994					1968	1993	FEB 1973
	MAXIMUM IN 24 HOURS (IN)	50	2.6	13.7	1.1	T	0.0	T	0.0	0.0	0.0	0.0	T	1.0	13.7
	YEAR OF OCCURRENCE		1992	1973	1980	1992		1994					1968	1993	FEB 1973
	MAXIMUM SNOW DEPTH (IN)	48	2	13	1	0	0	0	0	0	0	0	0	1	13
	YEAR OF OCCURRENCE		1988	1973	1980									1958	FEB 1973
	NORMAL NO. DAYS WITH:														
	SNOWFALL ≥ 1.0	30	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3

Source: NCDC, 2005a

Table 2.3-3 Climatological Extremes at Selected NWS and Cooperative Observing Stations in the VEGP Site Area

Parameter	Waynesboro 2NE	Augusta WSO	Millen 4N	Midville Exp Station	Newington 2NE	Aiken 4NE	Blackville 3W	Springfield
Maximum Temperature	108 °F [a, b] (7/25/52); (7/14/80)	108 °F [a] (8/21/83)	109 °F [b] (7/24/52)	105 °F [a, b] (7/13/80); (8/21/83) (7/19/86); (7/21/86)	110 °F [a] (7/13/80)	109 °F [a] (8/22/83)	108 °F [a] (8/1/99)	NA [d]
Minimum Temperature	-1 °F [a, b] (1/20/85); (1/21/85)	-1 °F [a] (1/21/85)	0 °F [b] (1/21/85)	-1 °F [a] (1/21/85)	-1 °F [a] (1/21/85)	-4 °F [a] (1/21/85)	-1 °F [a] (1/21/85)	NA [d]
Maximum 24-hr Rainfall	7.40 in. [a] (10/3/94)	7.30 in. [a] (9/3/98)	8.02 in. [b] (8/29/64)	8.19 in. [a] (10/12/90)	5.50 in. [a] (10/10/90)	9.68 in. [a] (4/16/69)	7.53 in. [a] (9/30/59)	7.10 in. [b, c] (9/30/59)
Maximum Monthly Rainfall	16.99 in. [a, b] (10/94)	14.82 in. [a, b] (10/90)	13.45 in. [b] (8/64)	15.97 in. [b, c] (8/70)	15.29 in. [a, b] (7/89)	14.45 in. [a, b] (3/80)	14.67 in. [a, b] (10/90)	17.32 in. [b, c] (6/73)
Maximum 24-hr Snowfall	16.0 in. [a, b] (2/10/73)	8.0 in. [a, b] (2/9/73)	14.0 in. [b] (2/10/73)	14.0 in. [b, c] (2/10/73)	5.0 in. [a, b] (2/10/73)	15.0 in. [a, b] (2/10/73)	17.0 in. [b, c] (2/10/73)	8.0 in. [b, c] (2/11/73)
Maximum Monthly Snowfall	16.0 in. [a, b] (2/73)	14.0 in. [a, b] (2/73)	15.0 in. [b] (2/68)	14.0 in. [b, c] (2/73)	8.0 in. [a, b] (2/73)	15.0 in. [a, b] (2/73)	17.0 in. [b, c] (2/73)	15.0 in. [b, c] (2/73)

Sources: a – NCDC 2005b
b – SERCC 2006
c – NCDC 2002c
d – NA = Measurements not made at this station

Table 2.3-4 Mean Seasonal and Annual Morning and Afternoon Mixing Heights and Wind Speeds for Athens, Georgia

Parameter	Winter	Spring	Summer	Autumn	Annual
Mixing Height – AM (m)	407	383	390	314	374
Wind Speed – AM (m/sec)	6.0	5.3	3.8	4.4	4.9
Mixing Height – PM (m)	1042	1754	1918	1455	1542
Wind Speed – PM (m/sec)	7.0	7.2	4.9	5.7	6.2

Note: Mean wind speed values represent the arithmetic average of speeds observed at the surface and aloft within the mixed layer.

Source: Holzworth 1972

Table 2.3-5 Climatological Normals (Means) at Selected NWS and Cooperative Observing Stations in the VEGP Site Area

Station	Normal Annual Temperatures (^{O}F) [a]			Normal Annual Precipitation	
	Daily Maximum	Daily Minimum	Daily Mean	Rainfall [a] (inches)	Snowfall (inches)
Waynesboro 2NE	75.2	51.0	63.1	47.20	1.0 [b]
Augusta	75.7	50.6	63.2	44.58	1.4 [b]
Millen 4N	76.1	50.6	63.4	43.85	0.5 [c]
Midville Exp Station	76.9	52.9	65.0	44.90	0.1 [b]
Newington 2NE	76.2	52.5	64.4	47.81	0.8 [b]
Aiken 4NE	77.2	50.9	64.1	52.43	1.4 [b]
Blackville 3W	77.6	51.6	64.6	47.23	0.7 [b]
Springfield	NA [e]	NA [e]	NA [e]	46.28	0.7 [d]

Sources: a – NCDC 2002a
b – NCDC 2005b
c – SERCC 2006, based on available Period of Record (1930-1998)
d – SERCC 2006, based on available Period of Record (1948-2005)
e – NA = Measurements not made at this station

Table 2.3-6 Seasonal and Annual Mean Wind Speeds for the VEGP Site (1998–2002) and the Augusta, Georgia, NWS Station (1971–2000, Normals)

Primary Tower Elevation	Location	Winter	Spring	Summer	Autumn	Annual
Upper Level (60 m) (m/sec)	Plant Vogtle	5.0	5.0	4.1	4.4	4.6
Lower Level (10 m) (m/sec)	Plant Vogtle	2.6	2.8	2.4	2.3	2.5
Single Level (6.1 m) (m/sec)	Augusta WSO [a]	3.0	3.0	2.4	2.4	2.7

Notes: Winter = December, January, February
Spring = March, April, May
Summer = June, July, August
Autumn = September, October, November

Source: a - NCDC 2005a

Table 2.3-7 Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER – 10-M LEVEL
22.5° SECTOR WIDTH

START AND END OF PERIOD 98010101 - 02123124

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 5.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1189	1134	1919	2028	1392	824	948	864	906	1298	1541	1478	1804	1444	856	894
2	257	249	607	685	384	186	202	220	207	309	436	354	579	488	177	152
4	54	54	239	217	102	28	63	53	52	69	122	78	178	172	36	26
8	3	4	68	44	10	4	7	3	3	2	8	4	18	31	3	0
12	0	0	26	6	0	0	0	0	0	0	1	0	1	9	0	0
18	0	0	9	0	0	0	0	0	0	0	0	0	0	3	0	0
24	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 10.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	136	126	323	415	150	58	116	85	74	167	246	250	362	361	150	59
2	19	35	132	179	44	14	34	20	21	41	87	68	133	161	38	13
4	4	9	61	75	10	4	9	4	10	13	26	18	52	66	8	3
8	0	0	20	7	0	0	0	0	2	3	3	1	7	13	0	0
12	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 15.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	3	9	13	25	8	1	6	3	4	14	21	17	40	43	19	2
2	1	6	5	10	2	0	2	2	1	4	14	5	19	20	6	0
4	0	3	5	5	0	0	2	0	0	0	6	2	6	3	0	0
8	0	0	1	1	0	0	0	0	0	0	0	2	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-7 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 20.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	0	0	4	0	0	0	0	0	2	0	1	3	5	0	0
2	1	0	0	4	0	0	0	0	0	1	0	1	2	3	0	0
4	0	0	0	2	0	0	0	0	0	1	0	1	2	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 25.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
All Speeds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1330	1269	2255	2472	1550	883	1070	952	984	1481	1808	1746	2209	1853	1025	955
2	278	290	744	878	430	200	238	242	229	355	537	428	733	672	221	165
4	58	66	305	299	112	32	74	57	62	83	154	99	238	241	44	29
8	3	4	89	52	10	4	7	3	5	5	11	7	25	44	3	0
12	0	0	39	6	0	0	0	0	0	0	1	0	1	9	0	0
18	0	0	16	0	0	0	0	0	0	0	0	0	0	3	0	0
24	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-7 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 10-M LEVEL
67.5° SECTOR WIDTH

START AND END OF PERIOD 98010101 - 02123124

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 5.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1786	2550	3237	3467	2820	2020	1665	1658	1883	2295	2624	3044	3090	2736	2000	1307
2	1136	1774	2528	2782	2069	1318	1057	1096	1272	1586	1868	2253	2337	2063	1328	730
4	549	1080	1844	2051	1274	740	557	632	711	904	1127	1436	1549	1400	743	326
8	179	553	1148	1297	561	301	200	263	269	305	495	662	774	756	334	65
12	69	332	737	862	285	138	75	149	114	85	238	331	396	440	169	9
18	26	157	444	501	113	52	16	67	29	24	87	147	142	200	69	0
24	13	75	295	303	40	14	3	24	12	7	36	68	30	88	28	0
30	6	38	194	185	13	0	0	6	6	0	12	31	0	40	4	0
36	0	17	122	120	5	0	0	0	0	0	1	14	0	21	0	0
48	0	5	48	48	0	0	0	0	0	0	0	2	0	9	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 10.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	165	370	620	658	463	229	168	167	191	307	426	580	688	628	409	160
2	97	231	494	550	327	127	106	108	106	199	298	419	529	517	304	77
4	37	130	356	419	199	50	51	59	44	96	161	249	354	382	195	32
8	0	54	193	251	81	4	14	24	5	29	59	92	166	219	104	7
12	0	31	106	146	27	0	3	10	0	9	24	32	86	130	64	0
18	0	13	49	74	10	0	0	1	0	0	3	6	28	62	32	0
24	0	1	18	53	4	0	0	0	0	0	0	0	2	32	18	0
30	0	0	11	41	0	0	0	0	0	0	0	0	0	20	12	0
36	0	0	5	29	0	0	0	0	0	0	0	0	0	14	6	0
48	0	0	0	16	0	0	0	0	0	0	0	0	0	2	0	0

PERSISTENCIES 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 15.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	10	17	30	28	22	11	8	10	14	30	39	67	89	94	58	19
2	5	9	20	22	18	2	1	2	4	16	25	40	66	79	37	6
4	1	7	13	17	12	0	0	0	0	7	11	17	39	58	18	0
8	0	3	3	9	6	0	0	0	0	0	3	3	13	32	3	0
12	0	0	0	2	2	0	0	0	0	0	0	0	6	16	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-7 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 20.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	1	4	4	4	0	0	0	1	1	2	4	9	8	5	1
2	0	0	3	3	3	0	0	0	0	0	1	1	6	5	2	0
4	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 25.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
All Speeds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1963	2939	3891	4157	3309	2260	1841	1835	2089	2633	3091	3695	3876	3466	2472	1488
2	1238	2014	3045	3357	2417	1447	1164	1206	1382	1801	2192	2713	2938	2664	1671	813
4	587	1217	2214	2488	1486	790	608	691	755	1007	1299	1702	1943	1841	956	358
8	179	610	1344	1557	648	305	214	287	274	334	557	757	953	1007	441	72
12	69	363	843	1010	314	138	78	159	114	94	262	363	488	586	233	9
18	26	170	493	575	123	52	16	68	29	24	90	153	170	268	101	0
24	13	76	313	356	44	14	3	24	12	7	36	68	32	120	46	0
30	6	38	205	226	13	0	0	6	6	0	12	31	0	60	16	0
36	0	17	127	149	5	0	0	0	0	0	1	14	0	35	6	0
48	0	5	48	64	0	0	0	0	0	0	0	2	0	11	0	0

Table 2.3-8 Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 60-M LEVEL
22.5° SECTOR WIDTH

START AND END OF PERIOD 98010101 - 02123124

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 5.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1770	2053	3155	2736	2059	1574	1684	2025	2330	2726	3482	3307	3138	2043	1674	1584
2	396	470	1085	822	658	394	385	665	653	740	989	913	1074	738	421	328
4	100	132	477	270	211	92	117	247	180	201	330	285	409	270	99	74
8	7	22	124	48	36	9	15	53	20	16	31	22	81	67	4	4
12	0	6	42	7	15	1	4	19	0	0	3	6	11	16	0	0
18	0	0	19	0	5	0	0	9	0	0	0	0	0	0	0	0
24	0	0	13	0	0	0	0	3	0	0	0	0	0	0	0	0
30	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 10.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	662	1014	1955	1457	995	747	806	713	1029	1612	2188	2123	2041	1249	783	621
2	128	238	780	496	351	174	207	280	218	482	668	627	764	554	218	130
4	38	68	381	172	125	36	76	102	57	153	237	224	320	233	55	28
8	2	14	124	31	23	4	12	16	5	12	26	24	67	62	3	1
12	0	6	51	7	12	0	3	7	0	0	3	6	9	15	0	0
18	0	0	19	0	2	0	0	1	0	0	0	0	0	0	0	0
24	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 15.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	143	229	525	265	106	68	112	75	171	366	638	727	736	436	149	123
2	14	54	238	100	35	6	22	12	32	104	189	176	258	222	37	20
4	3	23	117	31	17	0	3	2	6	36	72	54	113	108	12	4
8	0	10	41	9	5	0	0	0	0	3	7	0	26	31	2	1
12	0	6	24	4	0	0	0	0	0	0	0	0	3	4	0	1
18	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	1
24	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	1
30	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-8 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 20.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	33	21	44	25	12	9	16	4	19	48	99	135	184	118	36	12
2	0	10	9	14	3	0	3	2	5	14	19	37	74	64	15	1
4	0	7	4	11	0	0	3	0	0	2	4	11	44	36	6	0
8	0	1	0	6	0	0	0	0	0	0	1	0	14	12	1	0
12	0	0	0	2	0	0	0	0	0	0	0	0	6	6	1	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
Speed GE 25.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	2	0	5	5	1	0	0	0	2	6	15	26	37	21	5	3
2	0	0	0	3	1	0	0	0	1	0	8	3	23	13	1	0
4	0	0	0	1	1	0	0	0	1	0	5	2	14	7	0	0
8	0	0	0	0	0	0	0	0	0	0	0	2	5	4	0	0
12	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)
All Speeds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	2610	3317	5684	4488	3173	2398	2618	2817	3551	4758	6422	6318	6136	3867	2647	2343
2	538	772	2112	1435	1048	574	617	959	909	1340	1873	1756	2193	1591	692	479
4	141	230	979	485	354	128	199	351	244	392	648	576	900	654	172	106
8	9	47	289	94	64	13	27	69	25	31	65	48	193	176	10	6
12	0	18	117	20	27	1	7	26	0	0	6	13	34	41	1	1
18	0	0	55	0	7	0	0	10	0	0	0	0	0	0	1	1
24	0	0	37	0	0	0	0	3	0	0	0	0	0	0	0	1
30	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	1
36	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-8 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 60-M LEVEL
67.5° SECTOR WIDTH

START AND END OF PERIOD 98010101 - 02123124

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 5.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	2855	3961	4658	4948	3935	3182	3090	3545	4191	4860	5381	5834	5371	4472	3297	2294
2	1946	2981	3796	4027	2937	2282	2216	2652	3215	3715	4238	4702	4267	3444	2356	1508
4	1060	1996	2834	2952	1880	1375	1316	1695	2146	2455	2892	3389	3036	2375	1395	776
8	450	1117	1789	1776	858	570	546	799	1041	1158	1513	1897	1744	1352	561	236
12	237	708	1216	1133	413	240	259	416	509	536	828	1105	1077	823	244	60
18	117	394	755	625	141	52	115	180	189	190	356	539	552	423	92	2
24	66	244	514	350	57	7	54	85	85	64	181	292	296	231	47	0
30	36	162	348	204	11	0	26	42	38	22	88	188	136	115	17	0
36	14	118	224	118	3	0	7	16	19	5	33	116	55	57	3	0
48	0	55	102	38	0	0	0	0	2	0	0	62	9	11	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 10.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1124	2016	2590	2749	1943	1486	1367	1451	1916	2606	3291	3699	3466	2775	1781	958
2	743	1568	2216	2336	1456	1085	996	1029	1412	2038	2676	3032	2871	2258	1294	619
4	404	1096	1725	1811	901	675	599	639	875	1357	1909	2222	2153	1675	807	314
8	180	651	1149	1161	406	291	277	295	347	629	1067	1273	1319	1026	362	95
12	98	438	790	775	189	129	153	154	143	275	635	755	858	644	173	30
18	57	246	503	441	64	37	65	63	37	85	317	374	464	349	67	1
24	32	153	340	272	16	12	26	29	10	26	167	220	247	198	25	0
30	17	100	246	185	3	6	10	14	0	10	79	137	112	106	4	0
36	5	71	170	129	0	0	3	3	0	1	28	89	47	57	0	0
48	0	34	87	64	0	0	0	0	0	0	0	55	0	21	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 15.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	209	507	639	605	275	155	137	190	333	640	915	1156	1155	893	504	173
2	117	383	535	489	174	83	69	102	199	453	726	925	939	718	351	92
4	51	258	405	343	81	34	29	34	78	254	499	649	679	524	208	38
8	18	137	244	175	34	8	7	4	9	100	252	334	376	287	83	8
12	7	83	158	104	18	1	1	0	0	42	117	162	217	170	29	0
18	0	37	86	58	8	0	0	0	0	16	39	60	84	70	3	0
24	0	15	45	33	2	0	0	0	0	9	4	28	28	33	0	0
30	0	5	22	20	0	0	0	0	0	3	0	12	13	26	0	0
36	0	0	10	8	0	0	0	0	0	0	0	6	5	20	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0

Table 2.3-8 (cont.) Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 20.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	19	35	51	43	25	12	11	20	45	85	138	215	269	232	127	29
2	10	18	36	28	16	4	1	5	20	47	97	159	220	193	93	13
4	5	8	22	18	10	0	0	0	5	15	46	92	160	146	55	5
8	1	3	10	7	6	0	0	0	0	2	13	18	86	97	17	0
12	0	0	3	3	2	0	0	0	0	0	6	2	46	62	7	0
18	0	0	0	0	0	0	0	0	0	0	0	0	11	22	1	0
24	0	0	0	0	0	0	0	0	0	0	0	0	2	10	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
Speed GE 25.0 (MPH)

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	0	1	5	6	5	1	0	2	4	13	17	41	52	50	24	4
2	0	0	3	3	3	0	0	0	0	7	9	30	42	42	17	1
4	0	0	1	1	1	0	0	0	0	2	4	18	25	24	7	0
8	0	0	0	0	0	0	0	0	0	0	0	6	8	3	0	0
12	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)
All Speeds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	4207	6520	7943	8351	6183	4836	4605	5208	6489	8204	9742	10945	10313	8422	5733	3458
2	2816	4950	6586	6883	4586	3454	3282	3788	4846	6260	7746	8848	8339	6655	4111	2233
4	1520	3358	4987	5125	2873	2084	1944	2368	3104	4083	5350	6370	6053	4744	2472	1133
8	649	1908	3192	3119	1304	869	830	1098	1397	1889	2845	3528	3533	2765	1023	339
12	342	1229	2167	2015	622	370	413	570	652	853	1586	2025	2200	1699	453	90
18	174	677	1344	1124	213	89	180	243	226	291	712	973	1111	864	163	3
24	98	412	899	655	75	19	80	114	95	99	352	540	573	472	72	0
30	53	267	616	409	14	6	36	56	38	35	167	337	261	251	21	0
36	19	189	404	255	3	0	10	19	19	6	61	211	107	134	3	0
48	0	89	189	102	0	0	0	0	2	0	0	117	9	40	0	0

Table 2.3-9 Seasonal and Annual Vertical Stability Class and Mean 10-Meter Level Wind Speed Distributions for the VEGP Site (1998–2002)

	Vertical Stability Categories [a]						
Period	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Winter							
Frequency (%)	2.10	3.14	5.44	29.40	30.57	15.19	14.15
Wind Speed (m/sec)	3.8	3.8	3.5	3.1	2.7	1.8	1.4
Spring							
Frequency (%)	11.53	5.29	7.03	25.17	27.09	13.96	9.92
Wind Speed (m/sec)	3.6	3.7	3.6	3.3	2.5	1.8	1.4
Summer							
Frequency (%)	8.40	6.11	7.59	24.71	32.96	14.19	6.04
Wind Speed (m/sec)	3.4	3.1	2.9	2.7	2.2	1.5	1.4
Fall							
Frequency (%)	3.07	3.80	6.48	26.23	31.28	14.53	14.61
Wind Speed (m/sec)	3.5	3.3	3.1	2.8	2.3	1.7	1.2
Annual							
Frequency (%)	6.32	4.59	6.64	26.37	30.45	14.46	11.16
Wind Speed (m/sec)	3.5	3.5	3.3	3.0	2.4	1.7	1.3

Note: a - Vertical stability based on temperature difference (ΔT) between 10-m and 60-m measurement levels.

Table 2.3-10 Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: A Delta Temperature Extremely Unstable

Wind Direction (from)	Wind Speed (m/s) 0.23-0.50	0.51-0.75	0.76-1.00	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	> 18.0	Total
N	0	0	0	2	6	34	64	4	0	0	0	0	110
NNE	0	0	1	2	12	42	33	13	0	0	0	0	103
NE	0	0	0	3	6	31	79	17	0	0	0	0	136
ENE	0	0	0	2	10	67	127	30	0	0	0	0	236
E	0	0	0	5	12	73	133	10	0	0	0	0	233
ESE	0	0	1	5	12	64	55	0	0	0	0	0	137
SE	0	0	0	4	11	37	49	5	0	0	0	0	106
SSE	0	0	1	9	1	29	36	2	1	0	0	0	79
S	0	0	0	9	22	41	51	5	0	0	0	0	128
SSW	0	0	1	6	15	57	98	12	0	0	0	0	189
SW	0	0	2	6	18	69	119	20	3	0	0	0	237
WSW	0	0	0	4	22	79	168	27	3	0	0	0	303
W	0	1	1	4	13	83	160	29	2	0	0	0	293
WNW	0	0	0	4	10	40	91	20	3	0	0	0	168
NW	0	0	0	4	9	25	57	14	3	0	0	0	112
NNW	1	0	0	2	4	20	60	1	0	0	0	0	88
Totals	1	1	7	71	183	791	1380	209	15	0	0	0	2658

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: B Delta Temperature Moderately Unstable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	0	1	3	9	39	64	5	0	1	0	0	122
NNE	0	0	0	5	13	38	36	8	2	0	0	0	102
NE	0	1	0	4	7	40	48	7	0	0	0	0	107
ENE	1	0	0	1	11	54	69	23	0	0	0	0	159
E	0	0	0	5	4	44	65	8	0	0	0	0	126
ESE	0	0	1	6	6	31	22	3	0	0	0	0	69
SE	0	0	4	7	8	23	22	1	0	0	0	0	65
SSE	0	0	0	7	14	21	18	1	0	0	0	0	61
S	0	1	1	2	12	30	27	4	0	0	0	0	77
SSW	0	0	0	3	17	53	51	5	2	0	0	0	131
SW	0	0	1	9	18	51	75	19	2	0	0	0	175
WSW	0	0	0	5	7	61	64	18	1	0	0	0	156
W	0	0	0	2	9	61	97	23	3	0	0	0	195
WNW	0	0	1	3	8	37	75	28	4	1	0	0	157
NW	0	0	0	7	5	33	42	12	2	0	0	0	101
NNW	0	0	0	2	12	39	71	4	0	0	0	0	128
Totals	1	2	9	71	160	655	846	169	16	2	0	0	1931

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: C Delta Temperature Slightly Unstable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	0	0	7	22	76	77	5	1	0	0	0	188
NNE	1	0	4	6	15	66	61	3	0	0	0	0	156
NE	0	0	0	4	17	54	66	12	0	0	0	0	153
ENE	0	0	3	6	20	70	98	14	0	0	0	0	211
E	0	0	1	9	20	51	82	1	1	0	0	0	165
ESE	0	0	2	9	16	48	37	1	0	0	0	0	113
SE	0	1	1	9	18	39	24	3	1	0	0	0	96
SSE	0	0	1	8	9	26	35	8	1	0	0	0	88
S	0	0	1	8	27	56	37	4	0	0	0	0	133
SSW	0	1	0	6	21	62	70	8	1	0	0	0	169
SW	0	0	0	11	21	65	97	19	3	0	0	0	216
WSW	0	1	0	12	27	96	94	20	1	0	0	0	251
W	0	0	3	9	35	106	126	32	5	0	0	0	316
WNW	0	0	1	9	21	56	62	37	7	0	0	0	193
NW	0	1	1	4	25	67	62	14	4	0	0	0	178
NNW	2	1	2	3	19	79	60	1	0	0	0	0	167
Totals	3	5	20	120	333	1017	1088	182	25	0	0	0	2793

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: D Delta Temperature Neutral

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	7	13	72	136	330	211	29	0	0	0	0	798
NNE	2	6	9	69	102	262	193	30	2	0	0	0	675
NE	3	4	15	55	94	326	491	74	1	0	0	0	1063
ENE	2	4	11	57	90	295	422	79	4	1	0	0	965
E	1	10	17	64	113	260	202	20	3	0	0	0	690
ESE	3	5	14	48	71	163	123	9	0	0	0	0	436
SE	1	16	7	45	75	134	145	38	2	0	0	0	463
SSE	4	9	15	61	88	170	134	18	0	0	0	0	499
S	2	9	14	69	105	231	123	10	0	0	0	0	563
SSW	1	9	20	43	91	226	216	38	3	0	0	0	647
SW	2	3	13	78	113	261	236	37	7	0	0	0	750
WSW	1	8	18	62	127	272	244	53	2	1	0	0	788
W	1	5	11	67	110	257	328	83	16	0	0	0	878
WNW	6	3	16	57	107	210	270	81	14	0	0	0	764
NW	2	5	10	67	100	206	113	29	4	0	0	0	536
NNW	0	3	10	59	93	241	153	17	0	0	0	0	576
Totals	31	106	213	973	1615	3844	3604	645	58	2	0	0	11091

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: E Delta Temperature Slightly Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	9	16	27	89	98	172	115	12	1	0	0	0	539
NNE	11	12	37	90	98	237	137	14	1	0	0	0	637
NE	10	22	26	94	127	348	289	24	3	0	0	0	943
ENE	12	16	36	96	148	339	246	40	6	1	0	0	940
E	9	24	39	101	161	338	138	20	2	0	0	0	832
ESE	13	9	50	119	187	247	93	14	0	0	0	0	732
SE	13	22	49	110	186	301	174	12	0	0	0	0	867
SSE	15	25	49	174	258	341	127	10	0	0	0	0	999
S	10	21	60	249	242	287	84	9	1	0	0	0	963
SSW	4	20	46	153	206	281	151	17	1	0	0	0	879
SW	8	19	54	172	250	349	195	18	1	0	0	0	1066
WSW	10	20	42	199	235	278	89	12	1	0	0	0	886
W	5	14	58	132	161	289	177	18	0	0	0	0	854
WNW	11	10	25	114	123	224	203	33	1	0	0	0	744
NW	9	15	27	102	103	154	98	11	1	0	0	0	520
NNW	7	8	22	59	87	132	81	6	2	0	0	0	404
Totals	156	273	647	2053	2670	4317	2397	270	21	1	0	0	12805

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: F Delta Temperature Moderately Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	11	20	20	62	61	71	19	0	0	0	0	0	264
NNE	13	20	30	65	50	76	27	1	0	0	0	0	282
NE	21	13	24	71	71	114	24	1	0	0	0	0	339
ENE	16	25	26	80	94	170	33	1	0	0	0	0	445
E	14	27	45	101	136	128	17	0	0	0	0	0	468
ESE	15	24	37	99	113	76	3	0	0	0	0	0	367
SE	21	17	35	90	116	56	7	0	0	0	0	0	342
SSE	13	28	31	89	107	68	9	0	0	0	0	0	345
S	12	23	48	144	114	63	4	1	0	0	0	0	409
SSW	19	15	35	142	143	96	12	0	0	0	0	0	462
SW	19	23	35	149	225	106	13	0	0	0	0	0	570
WSW	11	17	47	180	228	112	2	0	0	0	0	0	597
W	10	17	50	169	131	68	14	1	0	0	0	0	460
WNW	8	25	28	103	110	45	16	3	0	0	0	0	338
NW	5	15	22	65	58	37	3	0	0	0	0	0	205
NNW	12	14	20	42	54	40	8	0	0	0	0	0	190
Totals	220	323	533	1651	1811	1326	211	8	0	0	0	0	6083

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: G Delta Temperature Extremely Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	26	31	49	74	45	18	5	0	0	0	0	0	248
NNE	25	26	33	33	12	16	1	0	1	0	0	0	147
NE	45	30	35	58	24	16	0	0	0	0	0	0	208
ENE	29	26	42	73	61	36	2	0	0	0	0	0	269
E	28	33	55	101	78	30	3	0	0	0	0	0	328
ESE	28	33	56	110	40	17	1	0	0	0	0	0	285
SE	21	31	39	48	48	20	3	0	0	0	0	0	210
SSE	20	34	43	46	36	14	2	0	0	0	0	0	195
S	15	20	41	58	47	22	1	0	1	0	0	0	205
SSW	24	22	56	104	110	48	5	0	0	0	0	0	369
SW	33	34	57	150	202	68	2	0	0	0	0	0	546
WSW	19	38	61	207	170	50	3	0	0	0	0	0	548
W	25	36	78	179	133	42	0	0	0	0	0	0	493
WNW	27	34	43	83	56	14	2	1	0	0	0	0	260
NW	35	32	32	41	21	6	0	0	0	0	0	0	167
NNW	21	25	44	82	28	16	1	0	0	0	0	0	217
Totals	421	485	764	1447	1111	433	31	1	2	0	0	0	4695

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-10 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Summary of All Stability Classes Delta Temperature

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	46	74	110	309	377	740	555	55	2	1	0	0	2269
NNE	52	64	114	270	302	737	488	69	6	0	0	0	2102
NE	79	70	100	289	346	929	997	135	4	0	0	0	2949
ENE	60	71	118	315	434	1031	997	187	10	2	0	0	3225
E	52	94	157	386	524	924	640	59	6	0	0	0	2842
ESE	59	71	161	396	445	646	334	27	0	0	0	0	2139
SE	56	87	135	313	462	610	424	59	3	0	0	0	2149
SSE	52	96	140	394	513	669	361	39	2	0	0	0	2266
S	39	74	165	539	569	730	327	33	2	0	0	0	2478
SSW	48	67	158	457	603	823	603	80	7	0	0	0	2846
SW	62	79	162	575	847	969	737	113	16	0	0	0	3560
WSW	41	84	168	669	816	948	664	130	8	1	0	0	3529
W	41	73	201	562	592	906	902	186	26	0	0	0	3489
WNW	52	72	114	373	435	626	719	203	29	1	0	0	2624
NW	51	68	92	290	321	528	375	80	14	0	0	0	1819
NNW	43	51	98	249	297	567	434	29	2	0	0	0	1770
Totals	833	1195	2193	6386	7883	12383	9557	1484	137	5	0	0	42056

Number of Calm Hours for this Table	186
Number of Variable Direction Hours for this Table	1787
Number of Invalid Hours	1581
Number of Valid Hours for this Table	42056
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: A Delta Temperature Extremely Unstable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	0	0	3	3	15	34	36	6	0	0	0	97
NNE	0	0	0	1	4	20	33	21	9	1	0	0	89
NE	0	0	0	1	2	18	81	88	28	0	0	0	218
ENE	0	0	1	3	6	31	138	71	15	1	0	0	266
E	0	0	0	1	2	26	85	26	2	0	0	0	142
ESE	1	0	0	4	3	17	50	21	1	0	0	0	97
SE	0	0	0	0	0	9	30	7	0	0	0	0	46
SSE	0	0	1	2	4	24	49	15	1	0	0	0	96
S	0	0	1	2	2	14	53	33	8	0	0	0	113
SSW	0	0	0	2	10	23	77	52	24	3	0	0	191
SW	0	0	0	2	10	28	96	116	64	13	0	0	329
WSW	0	0	0	2	6	22	97	116	78	15	5	0	341
W	0	0	0	0	9	32	59	51	58	5	0	0	214
WNW	0	0	0	0	0	9	38	39	13	7	0	0	106
NW	0	0	0	2	8	17	45	30	4	1	2	0	109
NNW	0	0	1	0	3	18	46	32	2	0	0	0	102
Totals	1	0	4	25	72	323	1011	754	313	46	7	0	2556

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: B Delta Temperature Moderately Unstable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	0	1	4	5	20	51	23	8	0	0	0	112
NNE	0	0	0	1	5	15	33	22	5	0	0	0	81
NE	0	1	0	4	1	20	60	46	12	0	0	0	144
ENE	0	0	0	2	3	23	67	35	4	0	0	0	134
E	0	0	0	2	3	18	43	21	1	0	0	0	88
ESE	0	0	0	1	2	18	27	10	0	0	0	0	58
SE	0	0	1	0	3	12	20	10	0	0	0	0	46
SSE	0	0	0	3	1	15	19	5	0	0	0	0	43
S	0	0	0	1	4	15	29	11	8	0	0	0	68
SSW	0	0	1	1	1	17	48	22	18	1	1	0	110
SW	0	0	0	0	8	28	80	49	35	4	1	0	205
WSW	0	0	0	1	6	26	75	49	35	7	1	0	200
W	0	0	0	2	6	17	67	50	29	12	0	0	183
WNW	0	0	0	1	3	14	47	26	17	7	2	0	117
NW	0	0	0	2	5	17	56	28	9	1	0	0	118
NNW	0	0	0	0	6	19	54	29	2	0	0	0	110
Totals	0	1	3	25	62	294	776	436	183	32	5	0	1817

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: C Delta Temperature Slightly Unstable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	0	0	0	4	14	49	75	24	4	0	0	0	170
NNE	1	1	1	3	10	30	57	22	7	0	0	0	132
NE	0	2	0	6	6	35	81	42	5	0	0	0	177
ENE	0	0	2	5	8	43	77	40	8	0	0	0	183
E	0	0	0	5	10	45	91	15	2	1	0	0	169
ESE	1	0	1	5	5	15	30	9	0	1	0	0	67
SE	0	0	1	1	7	17	33	9	1	0	0	0	69
SSE	0	0	0	6	4	23	41	7	6	1	0	0	88
S	0	0	0	3	11	35	45	10	9	0	0	0	113
SSW	0	0	0	4	8	34	70	29	11	3	0	0	159
SW	0	0	2	2	4	45	90	60	33	7	0	0	243
WSW	0	1	0	4	8	53	115	57	37	6	1	0	282
W	0	1	0	2	10	46	106	51	36	11	1	0	264
WNW	0	0	0	5	4	34	70	40	24	12	2	0	191
NW	1	0	1	5	12	41	90	30	5	2	0	0	187
NNW	0	1	3	5	4	41	79	22	5	0	0	0	160
Totals	3	6	11	65	125	586	1150	467	193	44	4	0	2654

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: D Delta Temperature Neutral

Wind Direction (from)	Wind Speed (m/s) 0.23-0.50	0.51-0.75	0.76-1.00	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	> 18.0	Total
N	2	2	0	23	47	160	279	104	39	3	0	0	659
NNE	0	4	9	24	48	124	290	169	57	2	0	0	727
NE	0	3	5	24	42	141	402	350	119	1	0	0	1087
ENE	2	1	8	27	59	155	333	178	46	3	2	0	814
E	2	4	6	23	40	116	229	93	27	1	0	0	541
ESE	2	0	6	21	32	78	135	52	12	2	0	0	340
SE	3	2	9	20	38	71	172	93	40	1	0	0	449
SSE	1	5	7	23	43	113	190	90	20	0	0	0	492
S	1	4	4	29	58	134	217	92	22	3	0	0	564
SSW	2	3	7	19	36	101	218	128	56	12	1	0	583
SW	1	3	6	21	48	133	299	172	104	12	1	0	800
WSW	2	3	6	21	37	147	294	225	151	22	2	0	910
W	0	4	9	24	45	142	280	191	149	46	8	0	898
WNW	0	5	6	26	35	91	185	131	79	21	0	0	579
NW	0	2	11	18	33	124	207	104	24	5	0	0	528
NNW	4	2	5	22	41	158	256	106	44	1	0	0	639
Totals	22	47	104	365	682	1988	3986	2278	989	135	14	0	10610

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: E Delta Temperature Slightly Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	3	2	8	19	21	99	234	119	23	8	0	0	536
NNE	1	0	2	19	25	99	271	229	64	0	0	0	710
NE	2	2	4	13	32	94	354	406	129	4	0	0	1040
ENE	1	1	4	19	34	91	372	297	52	4	3	0	878
E	1	2	4	15	21	83	324	206	27	3	0	0	686
ESE	3	2	6	16	26	73	288	222	24	1	0	0	661
SE	1	1	6	10	18	82	347	227	20	0	0	0	712
SSE	0	4	6	31	49	202	536	187	12	1	0	0	1028
S	0	3	6	28	48	200	446	237	30	2	1	0	1001
SSW	1	3	6	13	22	96	396	347	60	3	0	0	947
SW	1	4	3	20	30	82	434	386	102	8	0	0	1070
WSW	2	3	3	13	27	71	315	306	111	9	0	0	860
W	3	3	5	13	25	50	255	380	159	10	1	0	904
WNW	2	1	7	11	16	66	168	214	127	9	0	0	621
NW	1	3	3	16	17	61	172	150	47	2	0	0	472
NNW	2	1	7	14	24	66	145	94	18	3	1	0	375
Totals	24	35	80	270	435	1515	5057	4007	1005	67	6	0	12501

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: F Delta Temperature Moderately Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	1	3	2	12	10	46	87	55	9	0	0	0	225
NNE	0	0	2	4	16	46	129	66	15	0	0	0	278
NE	1	2	0	8	12	46	121	161	33	0	0	0	384
ENE	2	1	1	8	14	34	167	184	25	0	0	0	436
E	2	1	2	10	8	32	169	139	2	0	0	0	365
ESE	3	2	1	14	13	45	163	88	3	0	0	0	332
SE	0	1	3	7	15	44	162	85	6	0	0	0	323
SSE	1	2	4	18	27	95	149	95	6	0	0	0	397
S	1	1	11	25	30	79	165	154	8	0	0	0	474
SSW	1	5	3	4	9	49	195	221	28	0	0	0	515
SW	3	1	5	11	16	40	165	284	44	0	0	0	569
WSW	0	0	3	9	13	24	155	245	38	1	0	0	488
W	2	2	5	6	17	29	139	219	49	0	0	0	468
WNW	1	0	2	7	12	29	91	141	31	0	0	0	314
NW	0	0	3	5	7	29	80	81	5	0	0	0	210
NNW	1	1	3	5	12	30	74	51	7	0	0	0	184
Totals	19	22	50	153	231	697	2211	2269	309	1	0	0	5962

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: G Delta Temperature Extremely Stable

	Wind Speed (m/s)												
Wind Direction (from)	**0.23-0.50**	**0.51-0.75**	**0.76-1.00**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**> 18.0**	**Total**
N	2	3	4	11	19	40	75	26	3	0	1	0	184
NNE	2	2	2	12	15	55	85	17	1	0	0	0	191
NE	1	1	7	15	22	37	90	53	7	0	0	0	233
ENE	0	3	8	13	12	40	118	88	20	0	0	0	302
E	0	4	3	9	13	24	123	97	10	0	0	0	283
ESE	2	2	5	7	8	28	111	72	1	0	0	0	236
SE	1	1	3	9	20	37	90	43	2	0	0	0	206
SSE	1	2	7	17	29	76	82	39	4	0	0	0	257
S	1	1	7	18	33	70	113	93	27	0	0	0	363
SSW	1	3	5	13	12	34	135	171	44	0	0	0	418
SW	1	0	2	9	13	43	147	172	58	0	0	0	445
WSW	4	1	2	7	15	41	103	216	37	0	0	0	426
W	4	5	3	12	15	48	127	159	33	0	0	0	406
WNW	1	3	3	8	10	42	102	90	11	0	0	0	270
NW	1	1	6	11	12	47	99	50	4	0	0	0	231
NNW	0	0	3	8	16	44	57	31	2	0	0	0	161
Totals	22	32	70	179	264	706	1657	1417	264	0	1	0	4612

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-11 (cont.) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Summary of All Stability Classes Delta Temperature

Wind Direction (from)	Wind Speed (m/s) 0.23-0.50	0.51-0.75	0.76-1.00	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	> 18.0	Total
N	8	10	15	76	119	429	835	387	92	11	1	0	1983
NNE	4	7	16	64	123	389	898	546	158	3	0	0	2208
NE	4	11	16	71	117	391	1189	1146	333	5	0	0	3283
ENE	5	6	24	77	136	417	1272	893	170	8	5	0	3013
E	5	11	15	65	97	344	1064	597	71	5	0	0	2274
ESE	12	6	19	68	89	274	804	474	41	4	0	0	1791
SE	5	5	23	47	101	272	854	474	69	1	0	0	1851
SSE	3	13	25	100	157	548	1066	438	49	2	0	0	2401
S	3	9	29	106	186	547	1068	630	112	5	1	0	2696
SSW	5	14	22	56	98	354	1139	970	241	22	2	0	2923
SW	6	8	18	65	129	399	1311	1239	440	44	2	0	3661
WSW	8	8	14	57	112	384	1154	1214	487	60	9	0	3507
W	9	15	22	59	127	364	1033	1101	513	84	10	0	3337
WNW	4	9	18	58	80	285	701	681	302	56	4	0	2198
NW	3	6	24	59	94	336	749	473	98	11	2	0	1855
NNW	7	5	22	54	106	376	711	365	80	4	1	0	1731
Totals	91	143	322	1082	1871	6109	15848	11628	3256	325	37	0	40712

Number of Calm Hours for this Table	29
Number of Variable Direction Hours for this Table	499
Number of Invalid Hours	3082
Number of Valid Hours for this Table	40712
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-12 VEGP Onsite Weather Instruments

Sensed Parameter	Range	System Accuracy	Starting Threshold	Distance Constant	Damping Ratio	Elevation
			45-m Tower Instruments			
Wind Speed	0-100 mph (0-56 m/sec)	±0.5 mph (±0.22 m/sec)	1.0 mph (0.45 m/sec)	-----	-----	10 m
Wind Direction	0°-540°	±5°	1.0 mph (0.45 m/sec)	6.56 ft 2 m	0.4-0.6 with deflection of 15° and delay distance of ≤ 2 m	10 m
Ambient Temperature	-10°F to 120°F (-23° to 49°C)	±0.9°F (±0.5°C)	-----	-----	-----	10 m
Sigma-Theta	0°-100°	-----	-----	-----	See wind direction	10 m
			60-m Tower Instruments			
Wind Speed	0-100 mph (0-56 m/sec)	±0.5 mph (±0.22 m/sec)	1.0 mph (0.45 m/sec)	-----	-----	10 m; 60 m
Wind Direction	0°-540°	±5°	1.0 mph (0.45 m/sec)	6.56 ft 2 m	0.4-0.6 with deflection of 15° and delay distance of ≤ 2 m	10 m; 60 m
Ambient Temperature	-10°F to 120°F (-23° to 49°C)	±0.9°F (±0.5°C)	-----	-----	-----	10 m
Differential Temperature	-5°F to 10°F (-20°C to -12°C)	+0.27°F (±0.15°C) per 50-m height	-----	-----	-----	10 m – 60 m
Dew Point	-10°F to 120°F (-23°C to 49°C)	±2.7°F (±1.5°C)	-----	-----	-----	10 m
Precipitation	0-100 events/reset	±10% of the total accumulated catch	Resolution of 0.01 in. (0.25 mm)	-----	-----	Tower base
Sigma-Theta	0°-100°	-----	-----	-----	See wind direction	10 m; 60 m

Table 2.3-13 Annual Data Recovery Statistics - VEGP Primary Meteorological Tower (1998-2002)

Parameter	1998	1999	2000	2001	2002
Wind Speed (10m)	99.2	99.1	99.3	95.1	97.1
Wind Speed (60 m)	98.8	99.0	98.0	95.2	96.7
Wind Direction (10 m)	99.2	98.9	98.3	95.2	96.5
Wind Direction (60 m)	98.3	97.7	98.2	95.2	97.6
Δ-Temperature (60m – 10m) [a]	96.9	98.9	97.9	94.8	99.3 [b]
Temperature (10 m)	99.2	98.9	98.0	95.0	97.6 [b]
Dewpoint (10 m)	99.1	98.7	85.5	95.0	89.6
Rainfall	99.7	99.3	99.1	96.4	78.8
Composite Parameters					
WS/WD (10m), ΔT (60m-10m) [a]	96.7	98.6	97.7	94.7	95.3
WS/WD (60m), ΔT (60m-10m) [a]	96.3	97.3	97.7	94.7	96.1

Notes: a - Temperature difference (ΔT) between 10-m and 60-m levels.

b - Data recovery for Δ-Temperature is greater than the 10-m temperature parameter recovery rate due to data substitution by SNC in the 2002 data set for the ΔT parameter only.

Table 2.3-14 PAVAN Output – X/Q Values at the Dose Calculation EAB

```
1USNRC COMPUTER CODE-PAVAN, VERSION 2.0          RUN DATE: 3/23/2006
/PLANT NAME: Vogtle ESP                          METEOROLOGICAL INSTRUMENTATION
 DATA PERIOD: 1998-2002 JFD                      WIND SENSORS HEIGHT:   10 m
 TYPE OF RELEASE: Ground-Level Release           DELTA-T HEIGHTS: 10 m - 60 m
 SOURCE OF DATA: Onsite
 COMMENTS: Accidental Releases
 PROGRAM: PAVAN, 10/76, 8/79 REVISION, IMPLEMENTATION OF REGULATORY GUIDE 1.145
0                                      RELATIVE CONCENTRATION (X/Q) VALUES (SEC/CUBIC METER)
```

DOWNWIND SECTOR	DISTANCE (METERS)	0-2 HOURS	0-8 HOURS	8-24 HOURS	1-4 DAYS	4-30 DAYS	ANNUAL AVERAGE	HOURS PER YEAR MAX 0-2 HR X/Q IS EXCEEDED IN SECTOR	DOWNWIND SECTOR
S	800.	2.51E-04	1.67E-04	1.36E-04	8.78E-05	4.66E-05	2.15E-05	29.8	S
SSW	800.	2.21E-04	1.47E-04	1.20E-04	7.76E-05	4.14E-05	1.92E-05	525.9	SSW
SW	800.	2.55E-04	1.74E-04	1.44E-04	9.46E-05	5.20E-05	2.50E-05	33.9	SW
WSW	800.	2.62E-04	1.79E-04	1.48E-04	9.78E-05	5.40E-05	2.61E-05	31.9	WSW
W	800.	2.84E-04	1.94E-04	1.60E-04	1.06E-04	5.84E-05	2.82E-05	36.3	W
WNW	800.	2.81E-04	1.89E-04	1.55E-04	1.00E-04	5.40E-05	2.52E-05	35.9	WNW
NW	800.	2.46E-04	1.66E-04	1.36E-04	8.91E-05	4.83E-05	2.28E-05	30.0	NW
NNW	800.	2.44E-04	1.66E-04	1.38E-04	9.09E-05	5.01E-05	2.42E-05	28.9	NNW
N	800.	2.41E-04	1.66E-04	1.38E-04	9.21E-05	5.16E-05	2.54E-05	25.4	N
NNE	800.	2.75E-04	1.89E-04	1.57E-04	1.04E-04	5.82E-05	2.85E-05	33.6	NNE
NE	800.	3.11E-04	2.18E-04	1.83E-04	1.25E-04	7.18E-05	3.66E-05	43.7	NE
ENE	800.	3.05E-04	2.14E-04	1.80E-04	1.23E-04	7.09E-05	3.62E-05	41.7	ENE
E	800.	3.00E-04	2.09E-04	1.74E-04	1.17E-04	6.65E-05	3.32E-05	40.2	E
ESE	800.	2.57E-04	1.74E-04	1.43E-04	9.31E-05	5.05E-05	2.38E-05	31.0	ESE
SE	800.	2.11E-04	1.41E-04	1.15E-04	7.43E-05	3.97E-05	1.84E-05	26.3	SE
SSE	800.	2.38E-04	1.54E-04	1.24E-04	7.79E-05	3.98E-05	1.75E-05	26.4	SSE
MAX X/Q		3.11E-04				TOTAL HOURS AROUND SITE:		1020.9	
SITE LIMIT		3.00E-04	2.12E-04	1.78E-04	1.22E-04	7.10E-05	3.66E-05		

```
0THE FIVE-PERCENT-FOR-THE-ENTIRE-SITE X/Q IS LIMITING.
0**NOTE**: VALUES ON THIS PAGE ARE APPROXIMATIONS ONLY.  CHECK THE REASONABLENESS OF THE ENVELOPES COMPUTED FOR THE 0-2 HOUR VALUES.
           FOR ANY FAULTY ENVELOPES, ADJUST THE ABOVE VALUES.
```

Table 2.3-15 PAVAN Output – X/Q Values at the LPZ

```
1USNRC COMPUTER CODE-PAVAN, VERSION 2.0         RUN DATE: 3/23/2006
/PLANT NAME: Vogtle ESP                          METEOROLOGICAL INSTRUMENTATION
 DATA PERIOD: 1998-2002 JFD                      WIND SENSORS HEIGHT:   10 m
 TYPE OF RELEASE: Ground-Level Release           DELTA-T HEIGHTS: 10 m - 60 m
 SOURCE OF DATA: Onsite
 COMMENTS: Accidental Releases
 PROGRAM: PAVAN, 10/76, 8/79 REVISION, IMPLEMENTATION OF REGULATORY GUIDE 1.145
0                                     RELATIVE CONCENTRATION (X/Q) VALUES (SEC/CUBIC METER)
```

DOWNWIND SECTOR	DISTANCE (METERS)	0-2 HOURS	0-8 HOURS	8-24 HOURS	1-4 DAYS	4-30 DAYS	ANNUAL AVERAGE	HOURS PER YEAR MAX 0-2 HR X/Q IS EXCEEDED IN SECTOR	DOWNWIND SECTOR
S	2304.	8.86E-05	4.76E-05	3.49E-05	1.78E-05	6.77E-06	2.07E-06	31.2	S
SSW	2304.	7.29E-05	3.97E-05	2.93E-05	1.52E-05	5.89E-06	1.85E-06	530.5	SSW
SW	2304.	8.78E-05	4.85E-05	3.60E-05	1.89E-05	7.51E-06	2.42E-06	33.2	SW
WSW	2304.	9.00E-05	4.99E-05	3.71E-05	1.95E-05	7.79E-06	2.53E-06	31.0	WSW
W	2304.	9.98E-05	5.51E-05	4.09E-05	2.14E-05	8.49E-06	2.73E-06	36.2	W
WNW	2304.	1.01E-04	5.46E-05	4.02E-05	2.06E-05	7.90E-06	2.45E-06	36.9	WNW
NW	2304.	8.43E-05	4.62E-05	3.42E-05	1.78E-05	6.97E-06	2.21E-06	29.7	NW
NNW	2304.	8.47E-05	4.68E-05	3.48E-05	1.83E-05	7.27E-06	2.35E-06	29.6	NNW
N	2304.	8.29E-05	4.64E-05	3.47E-05	1.85E-05	7.46E-06	2.46E-06	25.7	N
NNE	2304.	9.86E-05	5.46E-05	4.06E-05	2.14E-05	8.52E-06	2.76E-06	34.8	NNE
NE	2304.	1.09E-04	6.19E-05	4.66E-05	2.52E-05	1.04E-05	3.54E-06	42.1	NE
ENE	2304.	1.10E-04	6.25E-05	4.70E-05	2.53E-05	1.04E-05	3.51E-06	43.0	ENE
E	2304.	1.11E-04	6.20E-05	4.62E-05	2.45E-05	9.81E-06	3.21E-06	43.7	E
ESE	2304.	9.08E-05	4.95E-05	3.65E-05	1.89E-05	7.34E-06	2.31E-06	31.1	ESE
SE	2304.	7.29E-05	3.95E-05	2.90E-05	1.49E-05	5.73E-06	1.78E-06	26.6	SE
SSE	2304.	8.40E-05	4.40E-05	3.19E-05	1.58E-05	5.77E-06	1.68E-06	27.8	SSE
MAX X/Q		1.11E-04					TOTAL HOURS AROUND SITE:	1033.1	
SITE LIMIT		1.10E-04	6.21E-05	4.68E-05	2.53E-05	1.04E-05	3.54E-06		

```
0THE FIVE-PERCENT-FOR-THE-ENTIRE-SITE X/Q IS LIMITING.
0**NOTE**: VALUES ON THIS PAGE ARE APPROXIMATIONS ONLY.  THE REASONABLENESS OF THE ENVELOPES COMPUTED FOR THE 0-2 HOUR VALUES.
           CHECK FOR ANY FAULTY ENVELOPES, ADJUST THE ABOVE VALUES.
```

Table 2.3-16 Shortest Distances Between the VEGP Units 3 and 4 Power Block Area and Receptors of Interest by Downwind Direction Sector [a]

Downwind Direction Sector	Meat Animal	Residence	Vegetable Garden	Dose Calculation EAB [b]
N	> 8,045	2,032 [c]	> 8,045	800
NNE	> 8,045	> 8,045	> 8,045	800
NE	> 8,045	> 8,045	> 8,045	800
ENE	> 8,045	> 8,045	> 8,045	800
E	> 8,045	> 8,045	> 8,045	800
ESE	> 8,045	7,118	> 8,045	800
SE	> 8,045	7,327	> 8,045	800
SSE	7,414	7,410	> 8,045	800
S	> 8,045	6,835	> 8,045	800
SSW	6,736	7,068	> 8,045	800
SW	7,155	3,633	> 8,045	800
WSW	6,366	1,071	4,273	800
W	6,170	5,024	> 8,045	800
WNW	> 8,045	2,069	4,458	800
NW	2,400	> 8,045	5,899	800
NNW	> 8,045	1,946 [c]	> 8,045	800

Notes:

a – Distances shown are in meters.

b – EAB = Exclusion Area Boundary.

c – Distances to nearest residences in N and NNW sectors (relative to proposed VEGP Units 3 and 4) are based on receptor locations in the NNW and NW sectors, respectively, as reported in AREOR (2004), which are located relative to VEGP Units 1 and 2.

d – There are no milk-giving animals (i.e., cows, goats) within a 5-mile radius of the VEGP Units 3 and 4 Site.

Table 2.3-17 XOQDOQ-Predicted Maximum X/Q and D/Q Values at Receptors of Interest

Type of Location	Direction from Site	Distance (miles)	X/Q (sec/m^3) (No Decay)	X/Q (sec/m^3) (2.26 Day Decay)	X/Q (sec/m3) (8 Day Decay)	D/Q (1/m^2)
Residence	WSW	0.67	2.5E-06	2.4E-06	2.2E-06	9.4E-09
Dose Calculation EAB	NE	0.5	5.4E-06	5.4E-06	4.9E-06	1.7E-08
Meat Animal	NW	1.49	6.4E-07	6.4E-07	5.5E-07	1.6E-09
Vegetable Garden	WSW	2.66	3.3E-07	3.3E-07	2.7E-07	8.7E-10

Table 2.3-18 XOQDOQ-Predicted Maximum Annual Average X/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

No Decay Undepleted	DISTANCE IN MILES FROM THE SITE									
NE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
X/Q (sec/m^3)	1.795E-5	5.331E-6	2.725E-6	1.749E-6	9.795E-7	6.535E-7	4.878E-7	3.853E-7	3.157E-7	2.658E-7	2.284E-7
	DISTANCE IN MILES FROM THE SITE										
NE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
X/Q (sec/m^3)	1.995E-7	1.188E-7	8.240E-8	4.940E-8	3.446E-8	2.610E-8	2.082E-8	1.721E-8	1.460E-8	1.263E-8	1.110E-8
	SEGMENT BOUNDARIES IN MILES FROM THE SITE										
NE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 – 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
X/Q (sec/m^3)	2.871E-6	1.006E-6	4.910E-7	3.166E-7	2.288E-7	1.205E-7	5.010E-8	2.622E-8	1.724E-8	1.264E-8	
2.26 Day Decay, Undepleted	DISTANCE IN MILES FROM THE SITE										
NE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
X/Q (sec/m^3)	1.792E-5	5.312E-6	2.711E-6	1.737E-6	9.692E-7	6.444E-7	4.793E-7	3.772E-7	3.080E-7	2.584E-7	2.212E-7
	DISTANCE IN MILES FROM THE SITE										
NE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
X/Q (s/m^3)	1.925E-7	1.127E-7	7.682E-8	4.454E-8	3.008E-8	2.208E-8	1.708E-8	1.371E-8	1.129E-8	9.496E-9	8.115E-9
	SEGMENT BOUNDARIES IN MILES FROM THE SITE										
NE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 – 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
X/Q (sec/m^3)	2.856E-6	9.955E-6	4.825E-7	3.089E-7	2.216E-7	1.145E-7	4.529E-8	2.221E-8	1.375E-8	9.517E-9	

Table 2.3-18 (cont.) XOQDOQ-Predicted Maximum Annual Average X/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

8.0 Day Decay, Depleted	DISTANCE IN MILES FROM THE SITE									
NE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
X/Q(sec/m^3)	1.698E-5	4.864E-6	2.425E-6	1.528E-6	8.293E-7	5.390E-7	3.931E-7	3.042E-7	2.446E-7	2.024E-7	1.711E-7
	DISTANCE IN MILES FROM THE SITE										
NE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
X/Q(sec/m^3)	1.472E-7	8.245E-8	5.423E-8	2.979E-8	1.932E-8	1.372E-8	1.033E-8	8.093E-9	6.529E-9	5.387E-9	4.524E-9
	SEGMENT BOUNDARIES IN MILES FROM THE SITE										
NE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
X/Q(sec/m^3)	2.568E-6	8.556E-7	3.965E-7	2.456E-7	1.715E-7	8.430E-8	3.057E-8	1.386E-8	8.136E-9	5.406E-9	
Relative Deposition /Area	DISTANCE IN MILES FROM THE SITE										
NE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
D/Q (1/m^2)	4.890E-8	1.654E-8	8.490E-9	5.213E-9	2.599E-9	1.576E-9	1.066E-9	7.723E-10	5.873E-10	4.627E-10	3.745E-10
	DISTANCE IN MILES FROM THE SITE										
NE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
D/Q (1/m^2)	3.098E-10	1.518E-10	9.527E-11	4.815E-11	2.914E-11	1.945E-11	1.400E-11	1.051E-11	8.175E-11	6.530E-12	5.330E-12
	SEGMENT BOUNDARIES IN MILES FROM THE SITE										
NE	0.5 - 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50	
D/Q (1/m^2)	8.822E-9	2.726E-9	1.085E-9	5.927E-10	3.767E-10	1.618E-10	5.017E-11	1.989E-11	1.062E-11	6.573E-12	

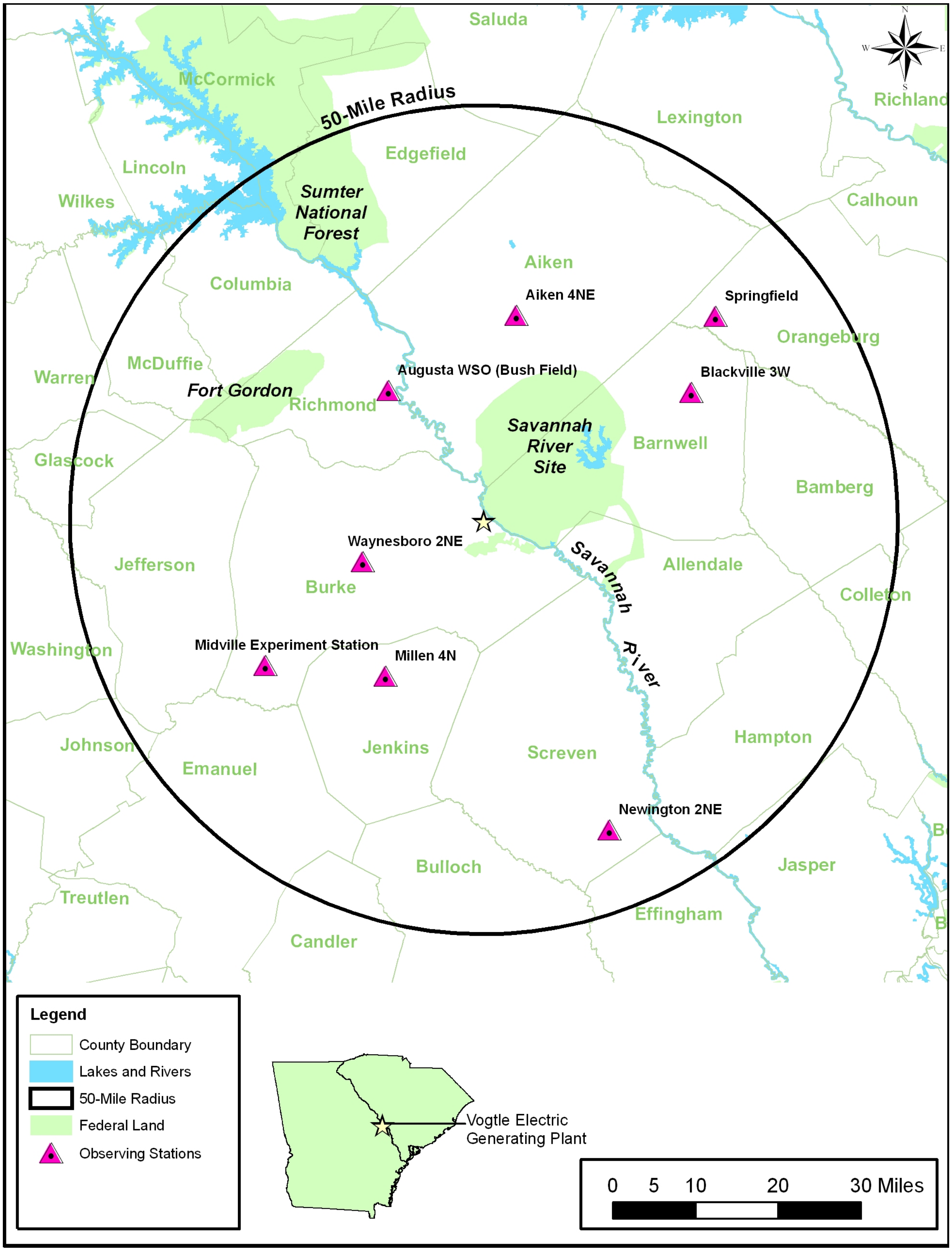

Figure 2.3-1 Climatological Observing Stations Near the VEGP Site

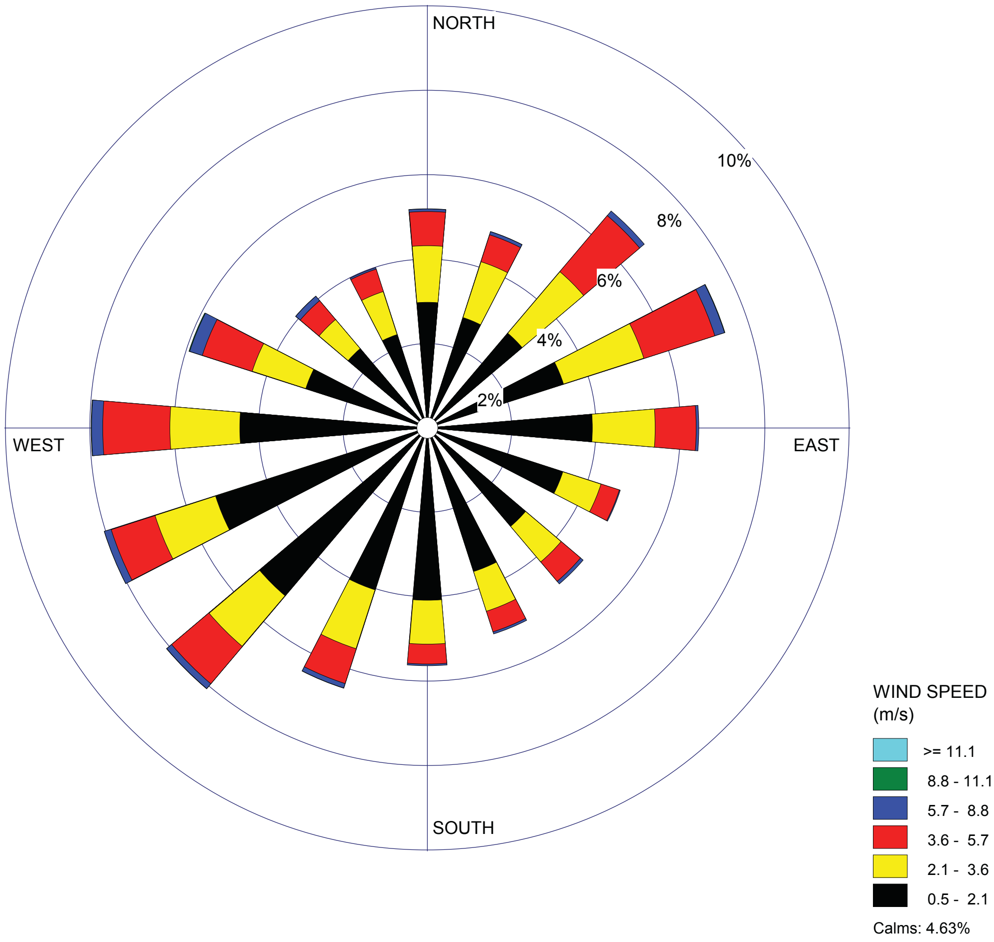

Figure 2.3-2 VEGP 10-m Level Annual Wind Rose (1998-2002)

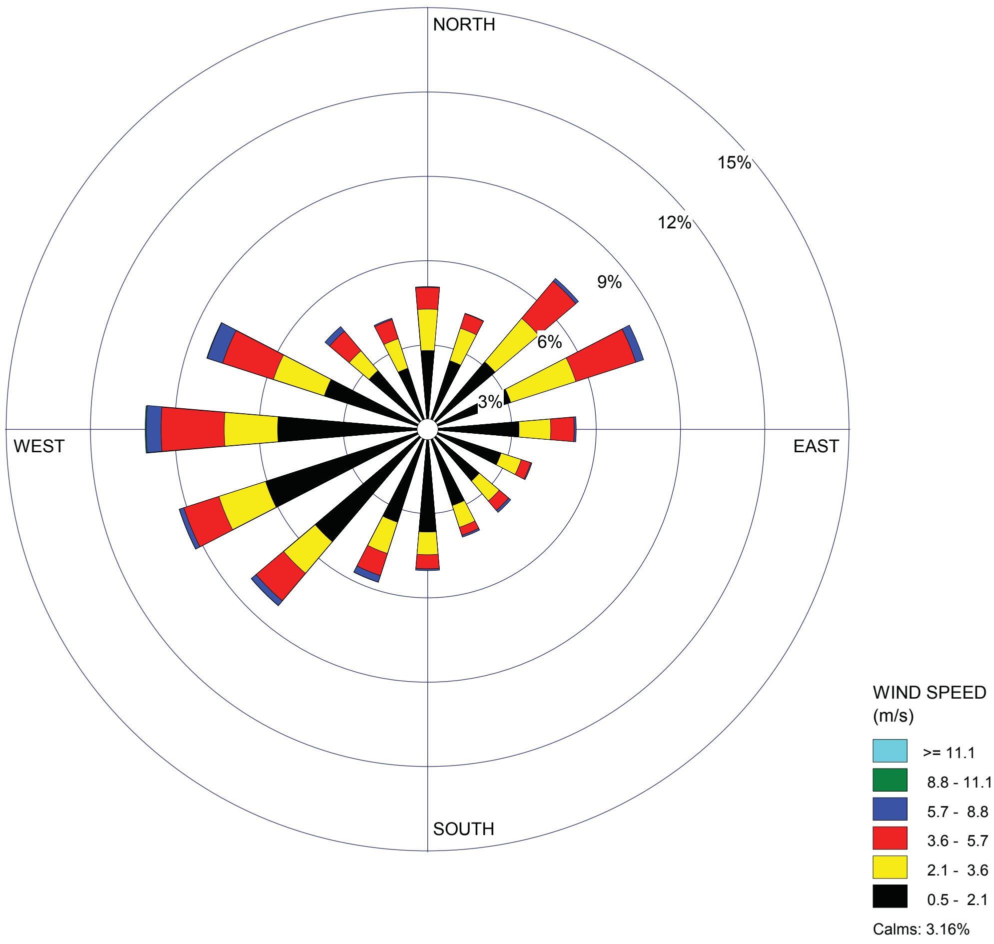

Figure 2.3-3 VEGP 10-m Level Winter Wind Rose (1998-2002)

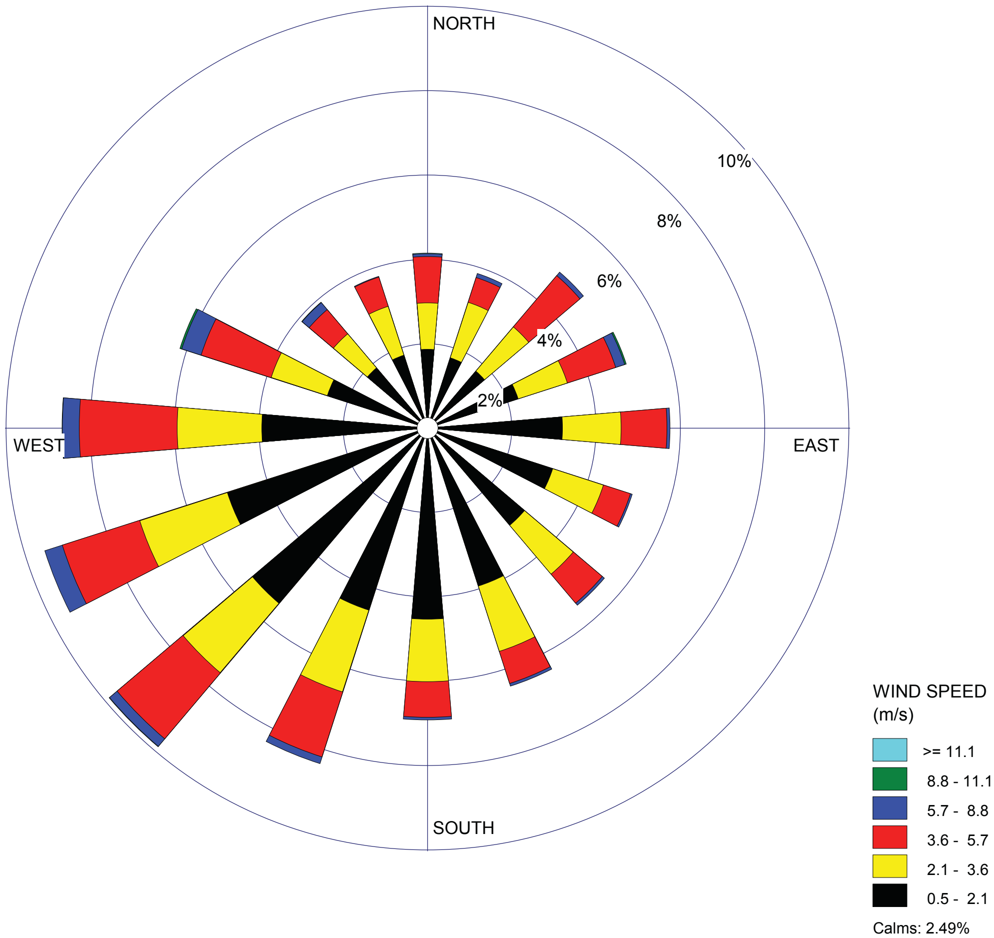

Figure 2.3-4 VEGP 10-m Level Spring Wind Rose (1998-2002)

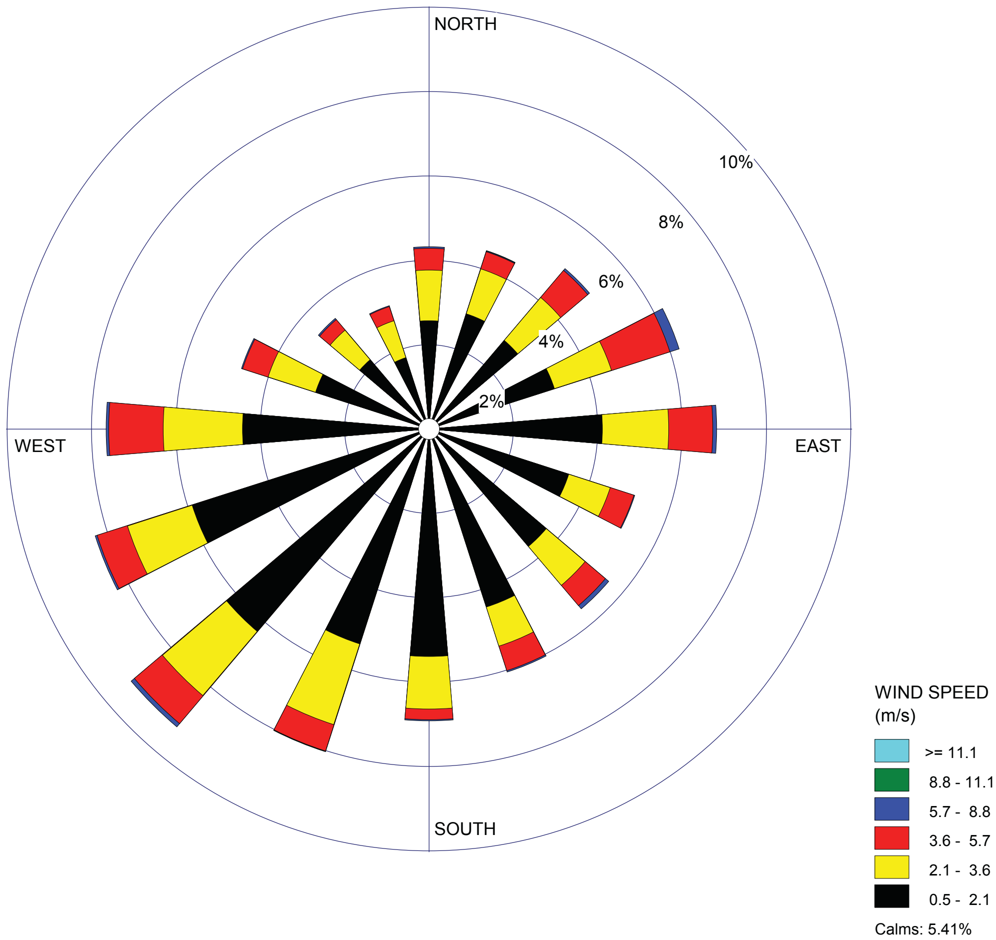

Figure 2.3-5 VEGP 10-m Level Summer Wind Rose (1998-2002)

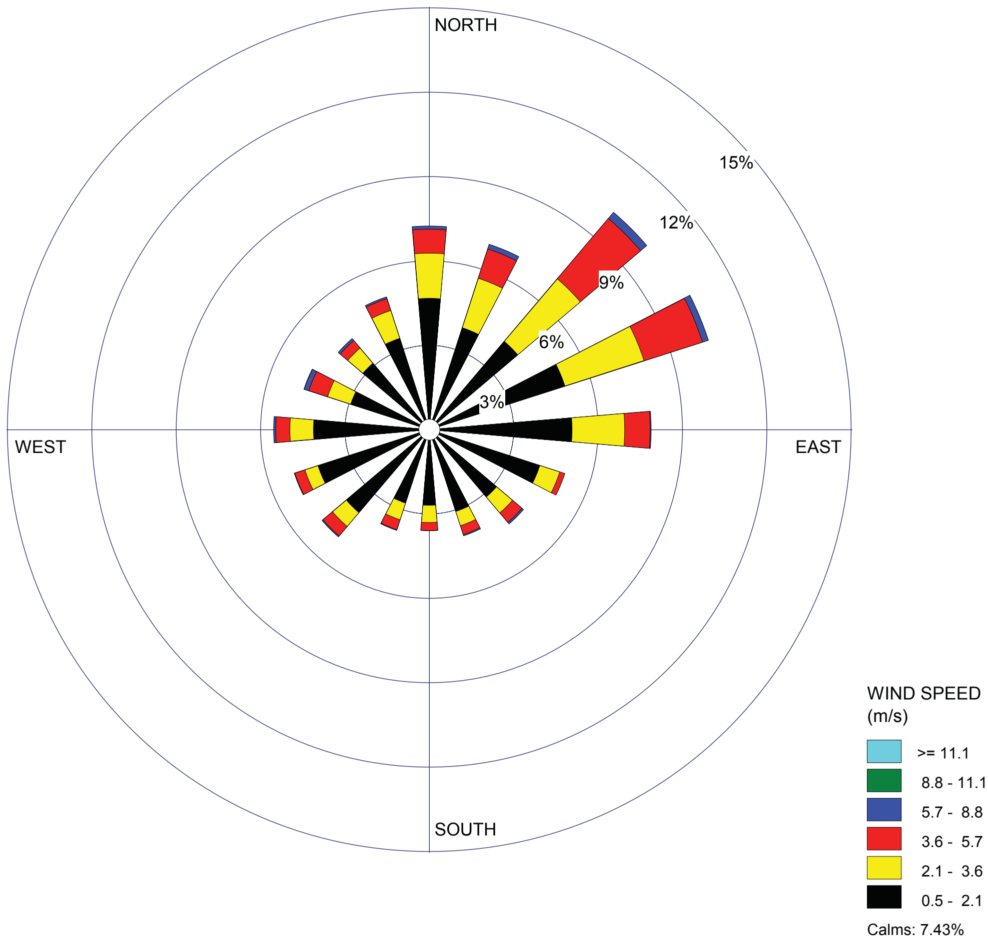

Figure 2.3-6 VEGP 10-m Level Autumn Wind Rose (1998-2002)

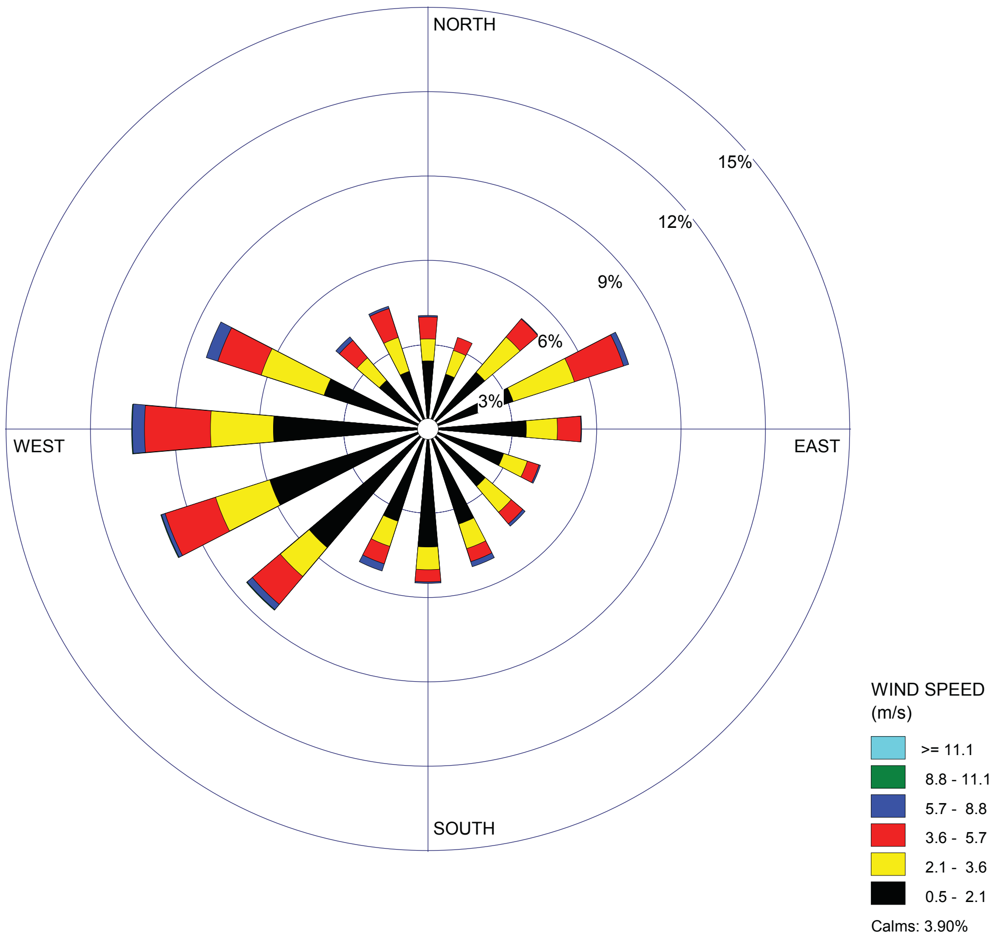

Figure 2.3-7 VEGP 10-m Level January Wind Rose (1998-2002) (Sheet 1 of 12)

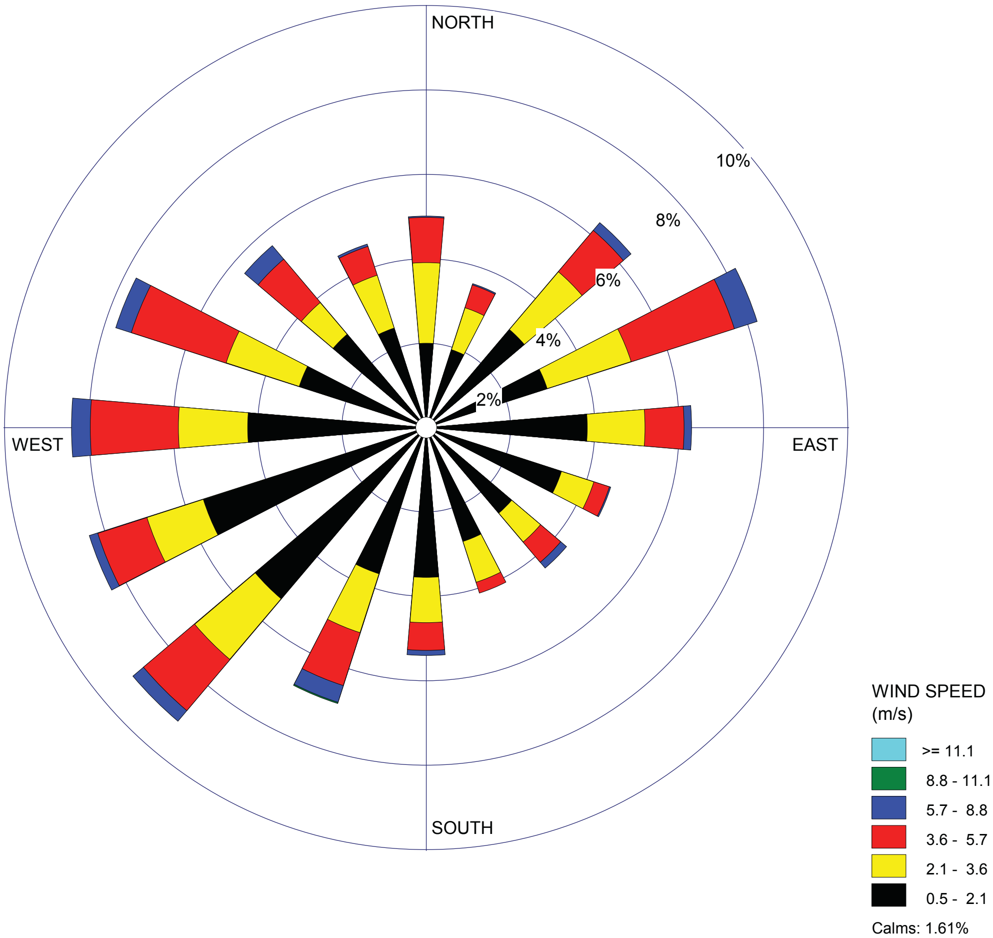

Figure 2.3-7 VEGP 10-m Level February Wind Rose (1998-2002) (Sheet 2 of 12)

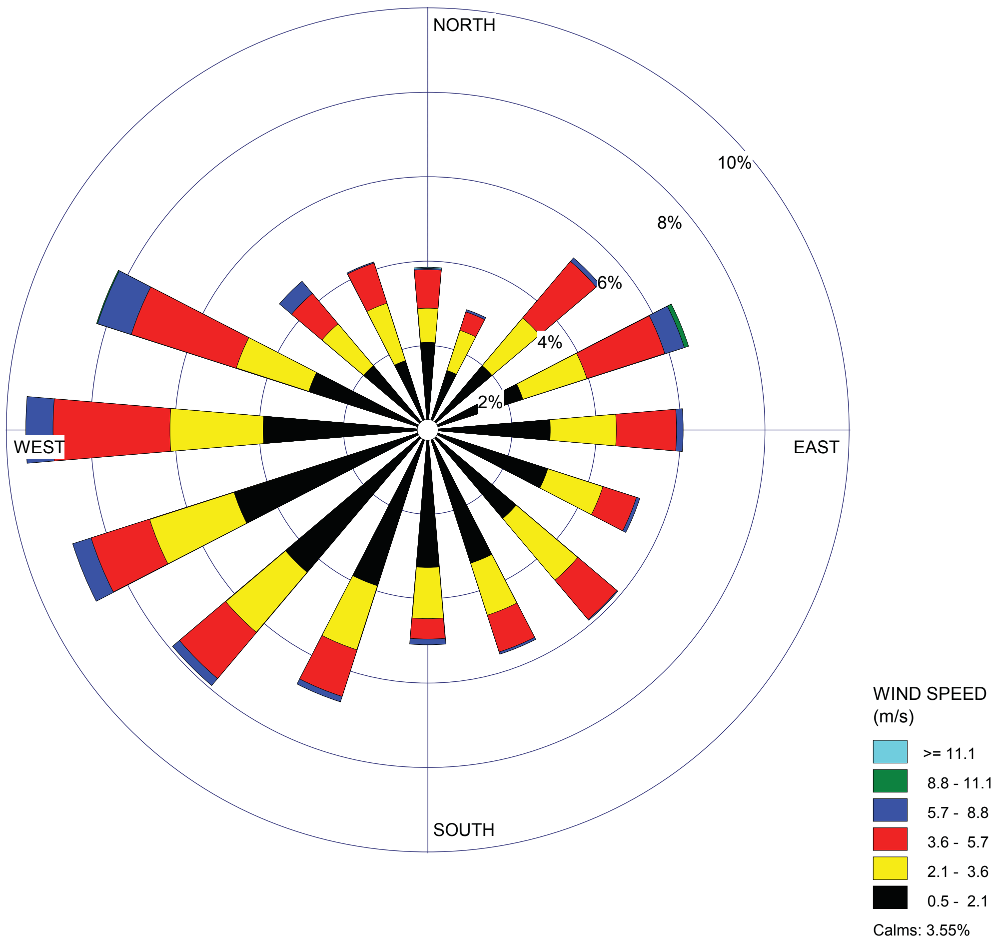

Figure 2.3-7 VEGP 10-m Level March Wind Rose (1998-2002) (Sheet 3 of 12)

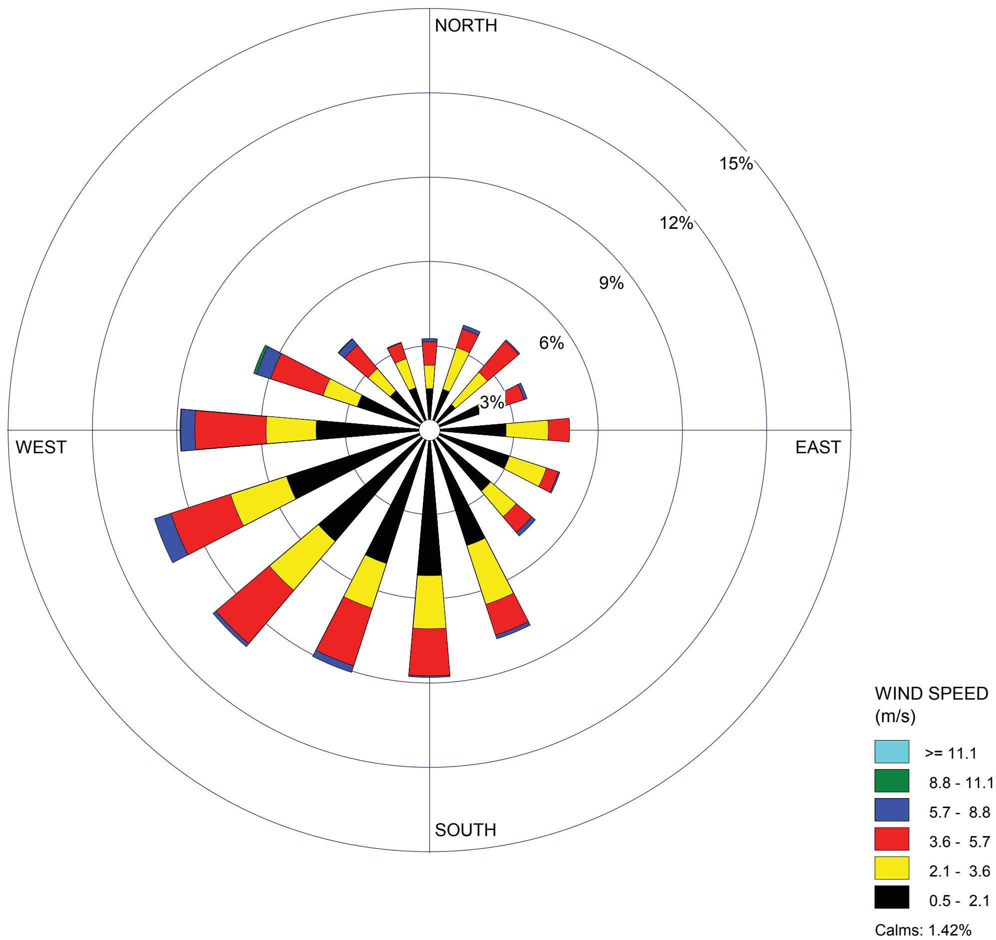

Figure 2.3-7 VEGP 10-m Level April Wind Rose (1998-2002) (Sheet 4 of 12)

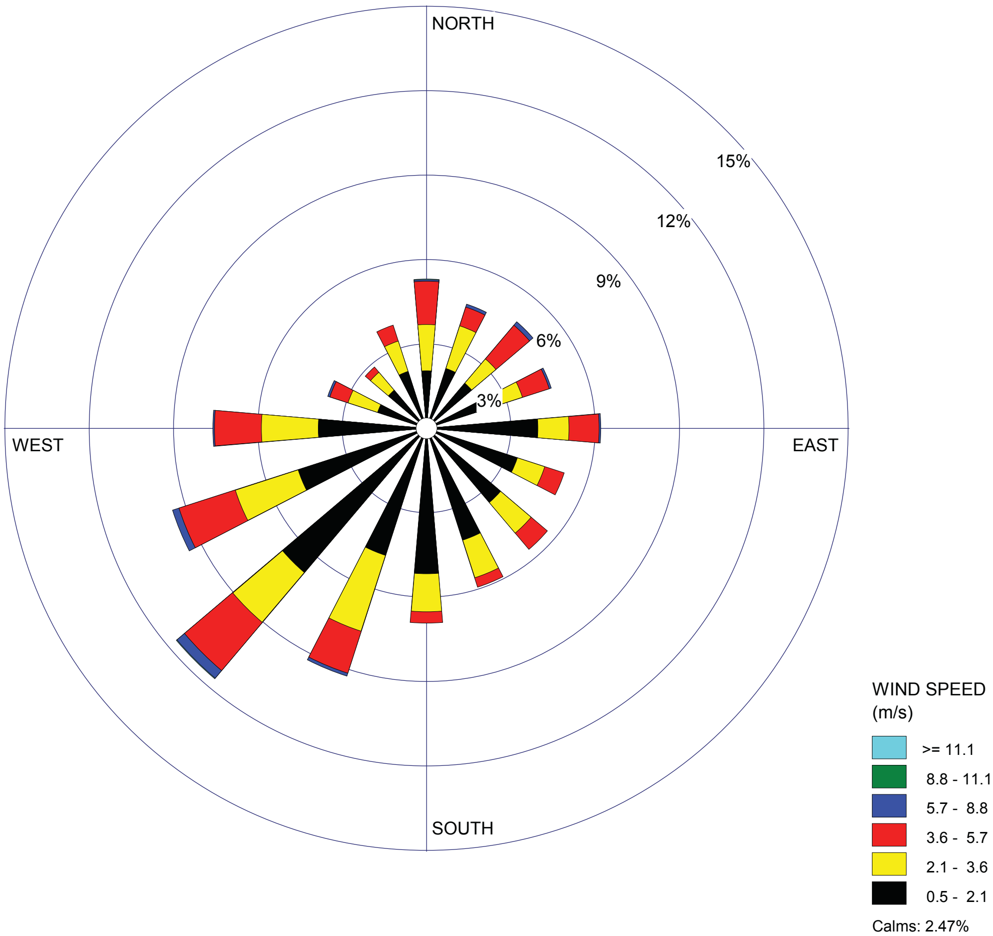

Figure 2.3-7 VEGP 10-m Level May Wind Rose (1998-2002) (Sheet 5 of 12)

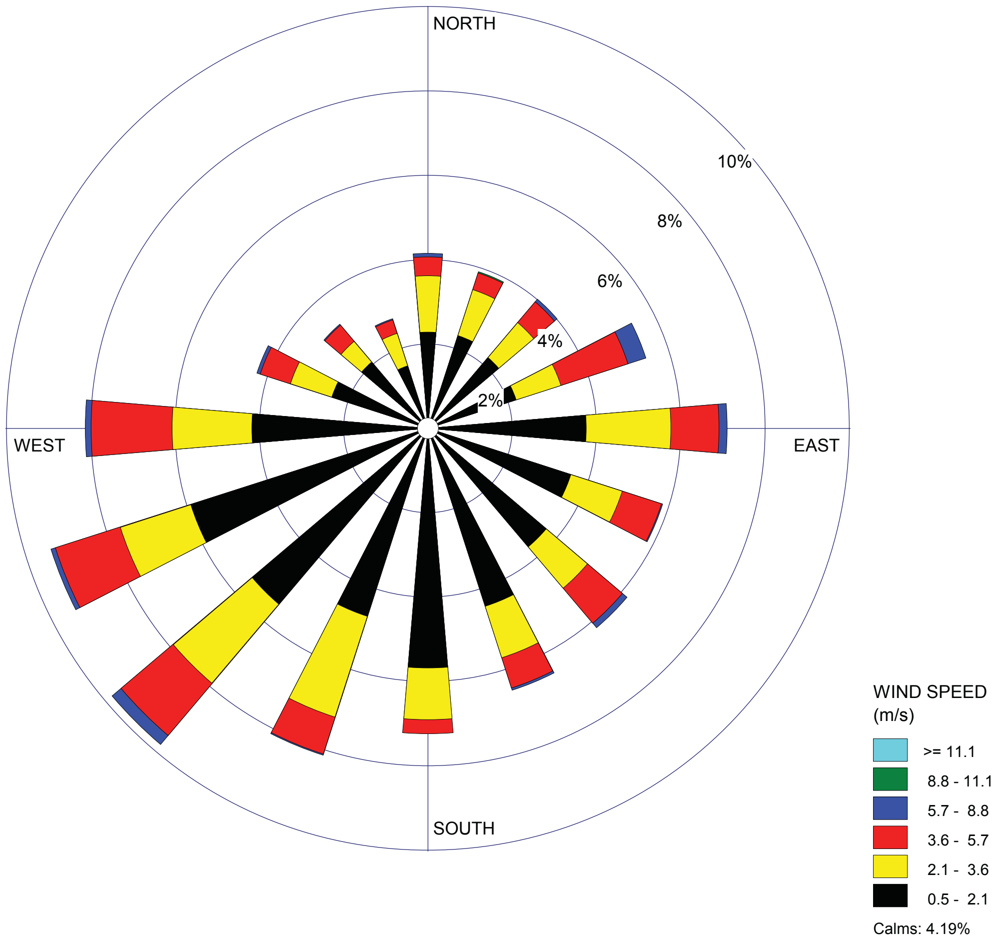

Figure 2.3-7 VEGP 10-m Level June Wind Rose (1998-2002) (Sheet 6 of 12)

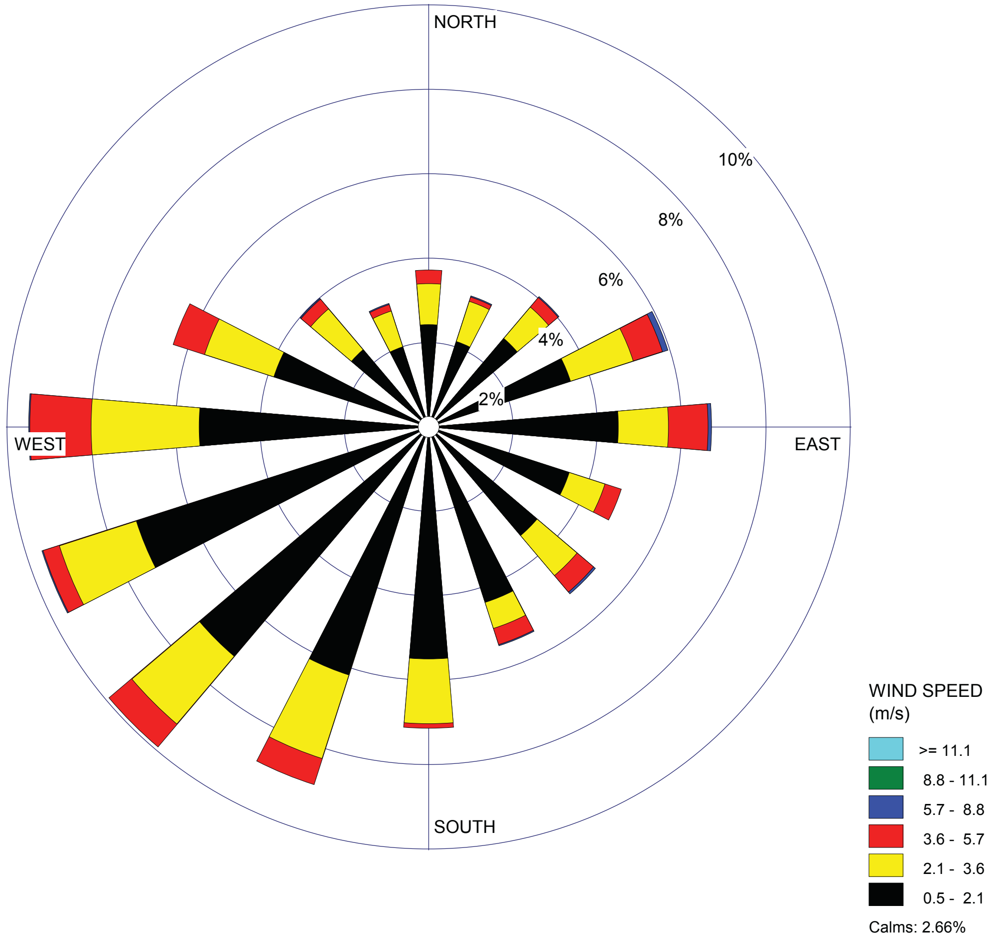

Figure 2.3-7 VEGP 10-m Level July Wind Rose (1998-2002) (Sheet 7 of 12)

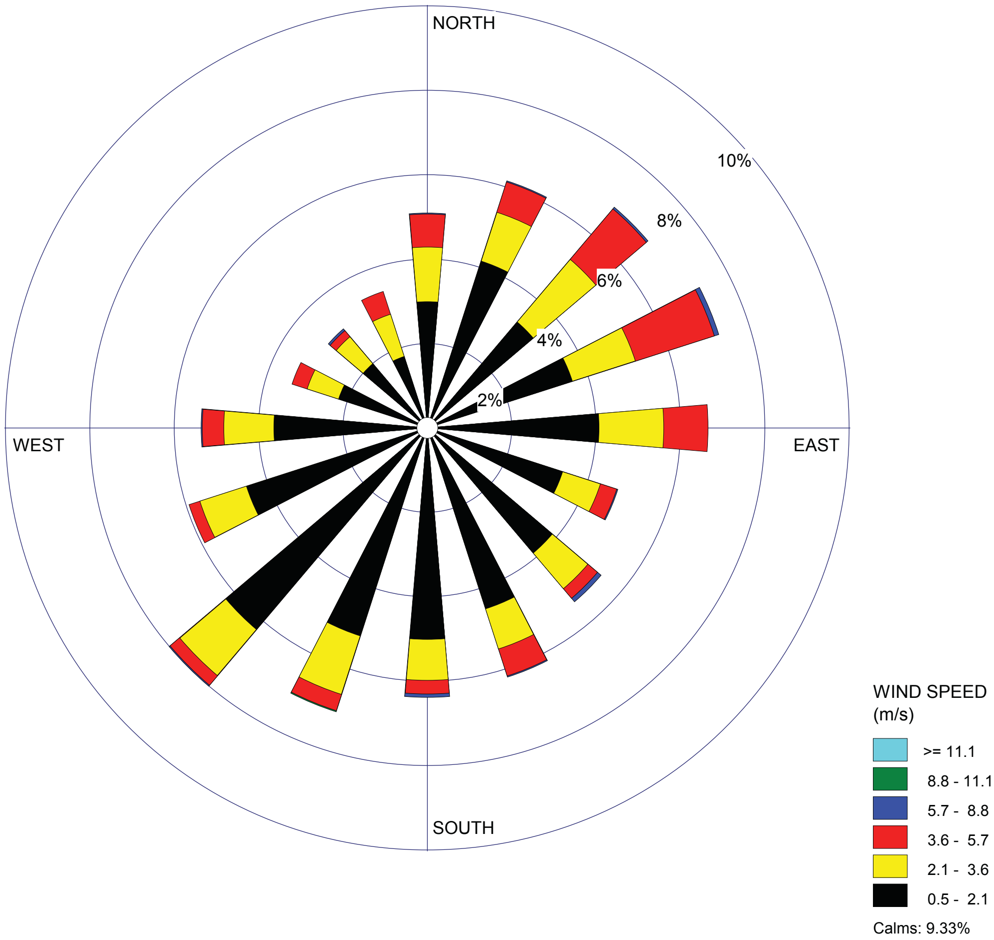

Figure 2.3-7 VEGP 10-m Level August Wind Rose (1998-2002) (Sheet 8 of 12)

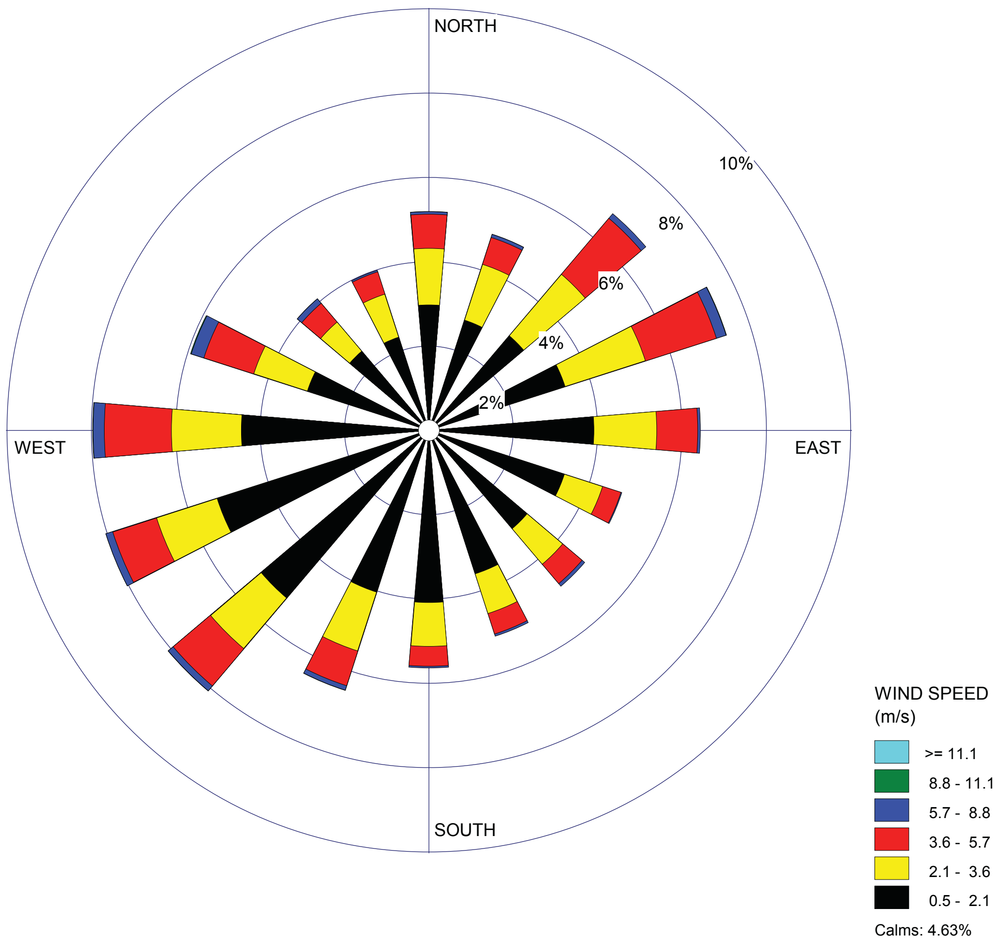

Figure 2.3-7 VEGP 10-m Level September Wind Rose (1998-2002) (Sheet 9 of 12)

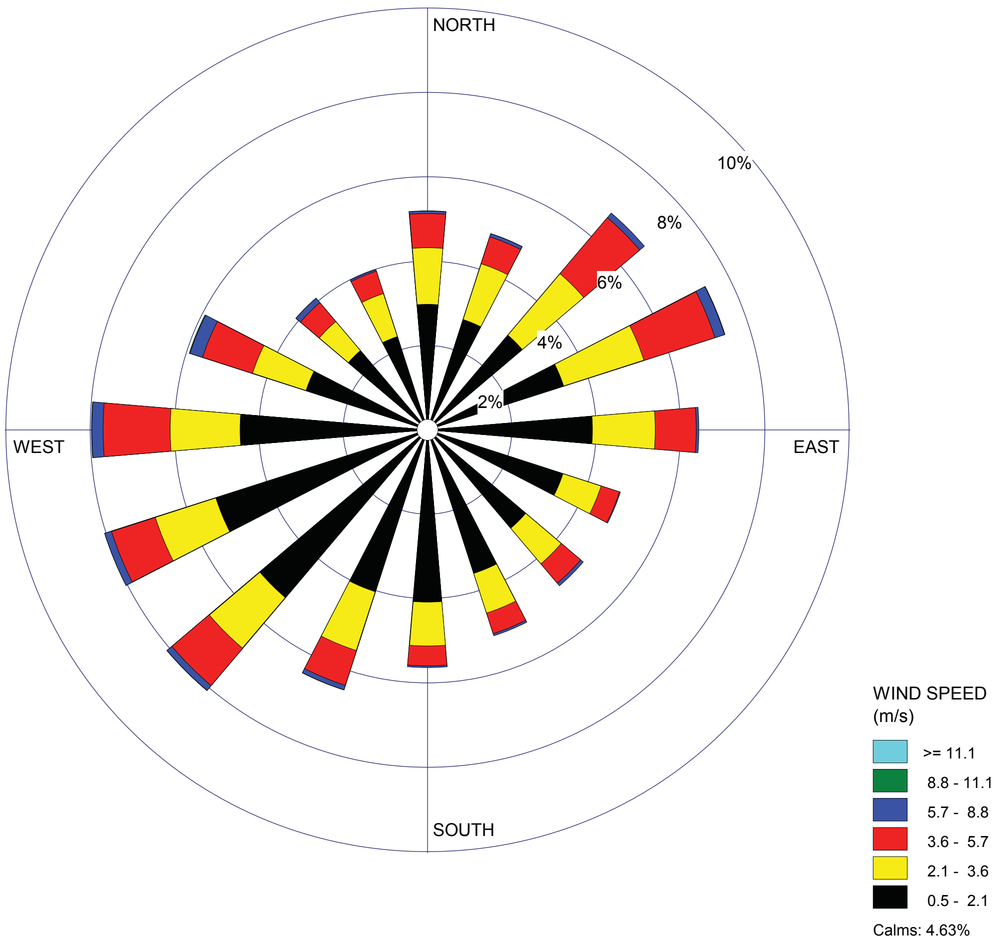

Figure 2.3-7 VEGP 10-m Level October Wind Rose (1998-2002) (Sheet 10 of 12)

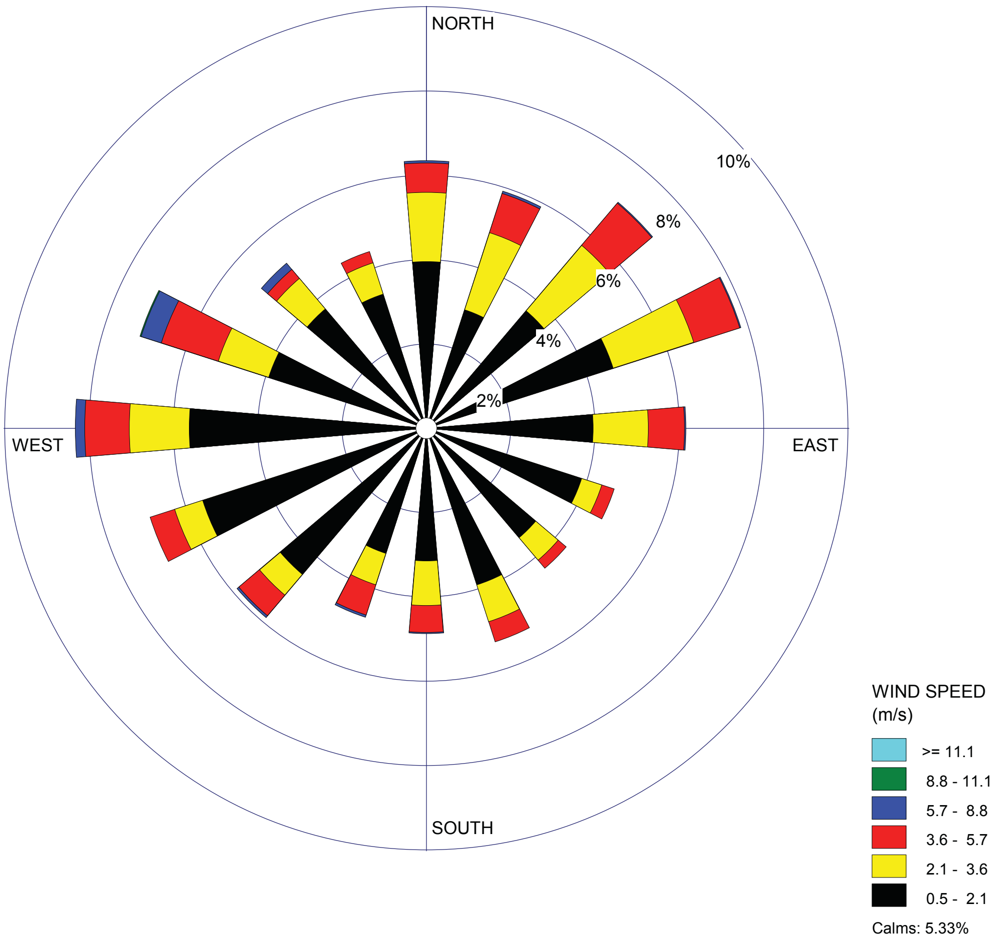

Figure 2.3-7 VEGP 10-m Level November Wind Rose (1998-2002) (Sheet 11 of 12)

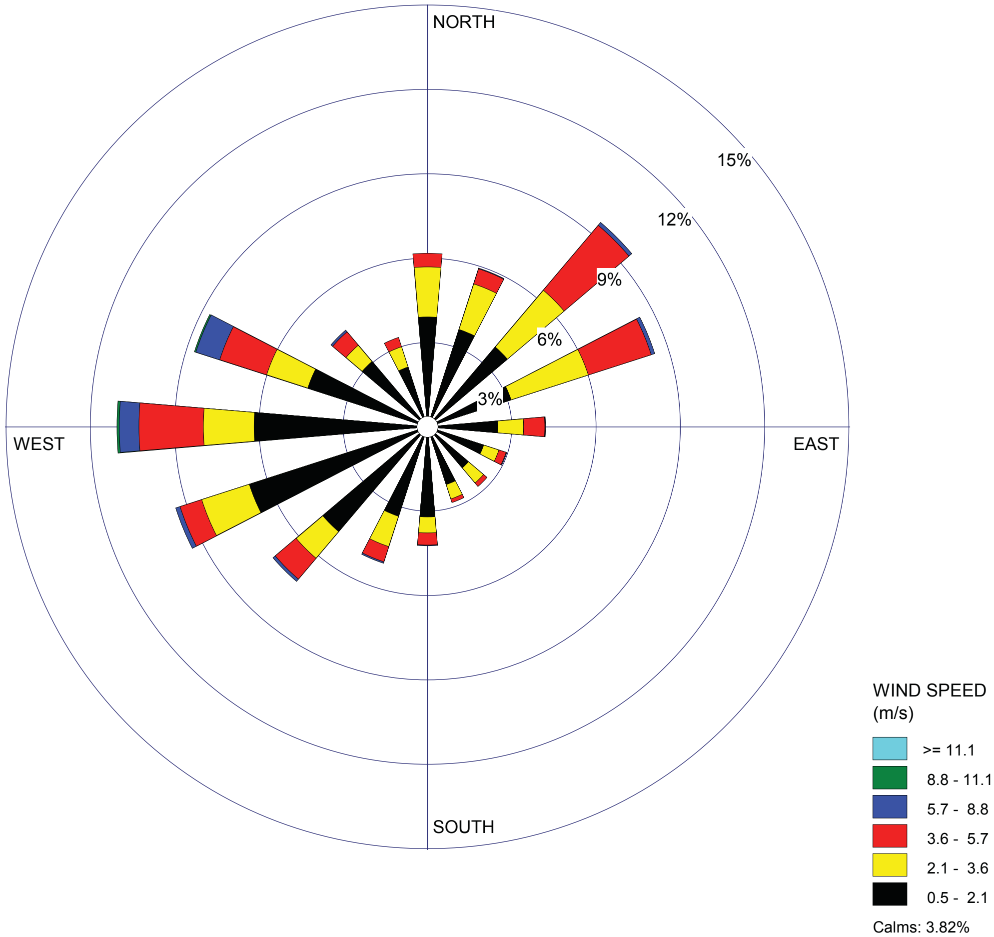

Figure 2.3-7 VEGP 10-m Level December Wind Rose (1998-2002) (Sheet 12 of 12)

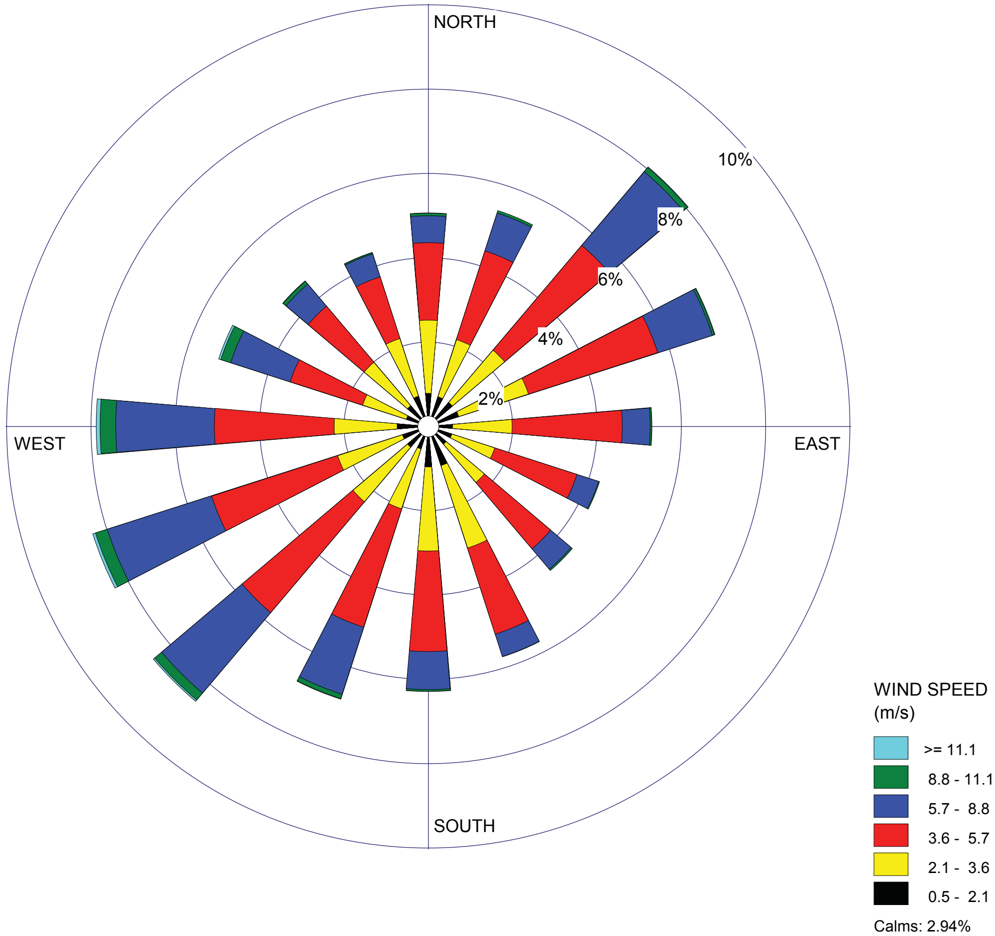

Figure 2.3-8 VEGP 60-m Level Annual Wind Rose (1998-2002)

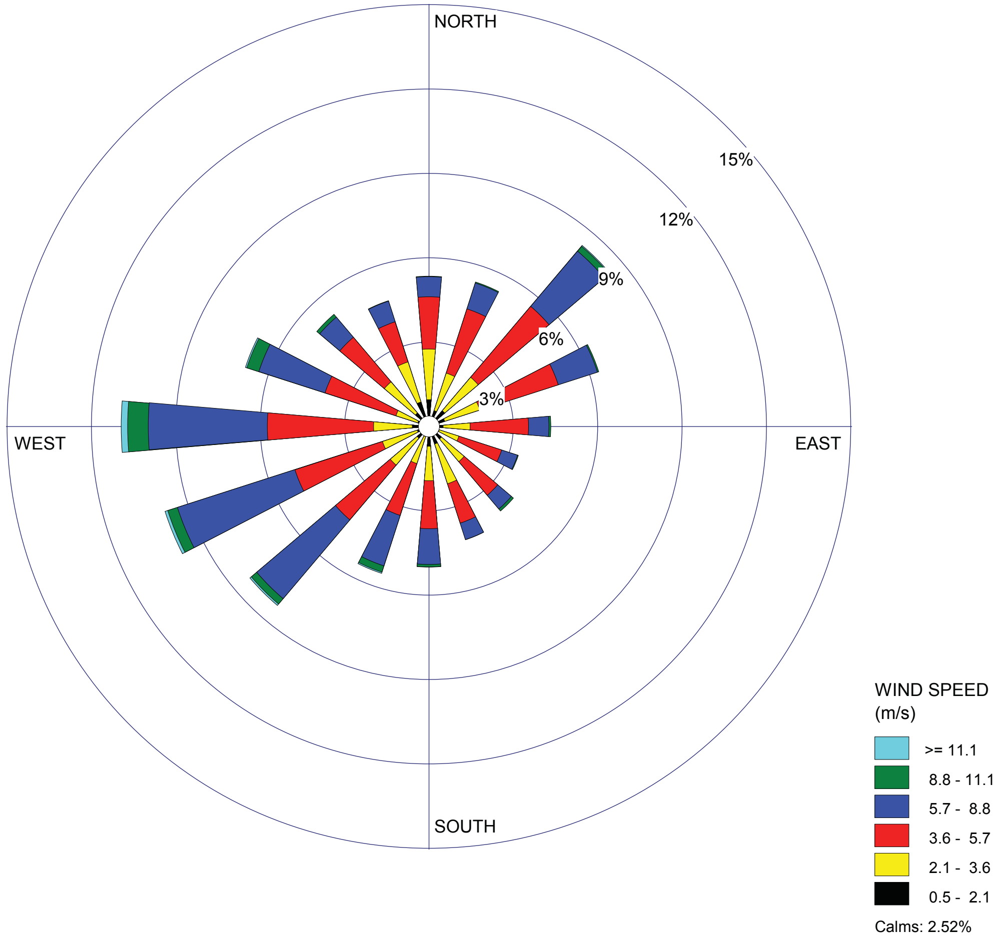

Figure 2.3-9 VEGP 60-m Level Winter Wind Rose (1998-2002)

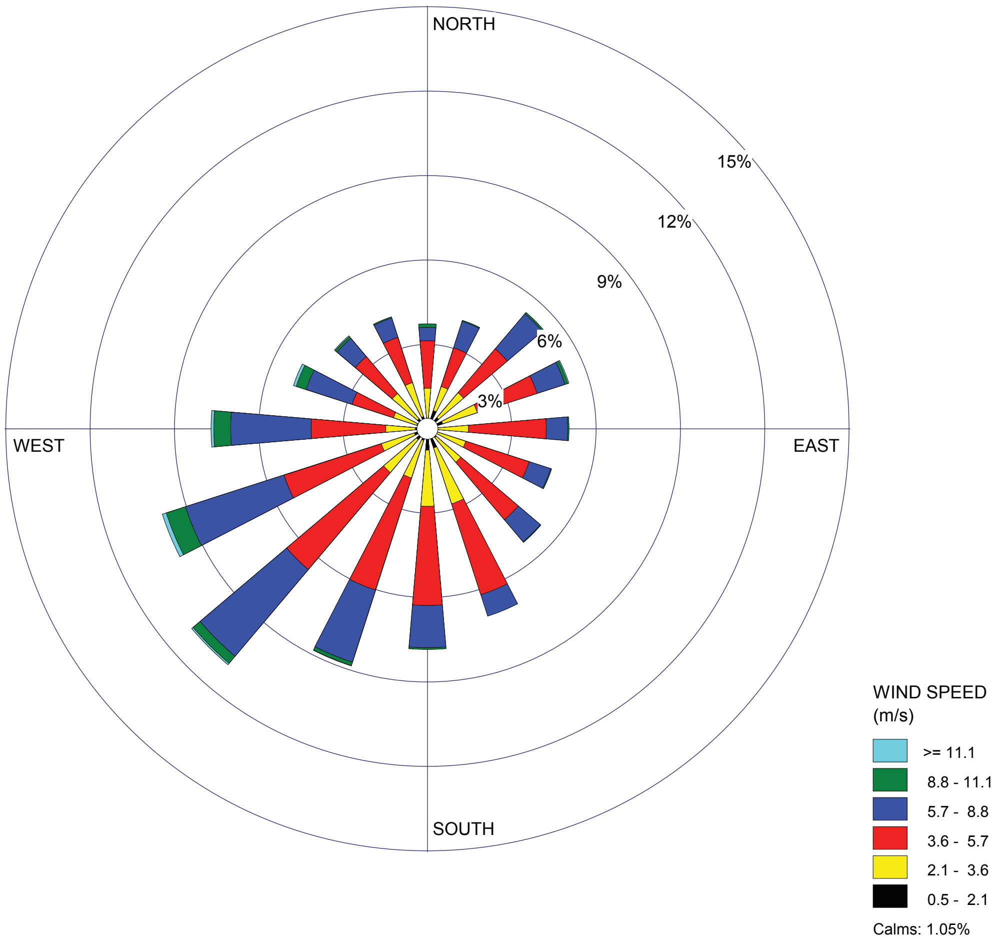

Figure 2.3-10 VEGP 60-m Level Spring Wind Rose (1998-2002)

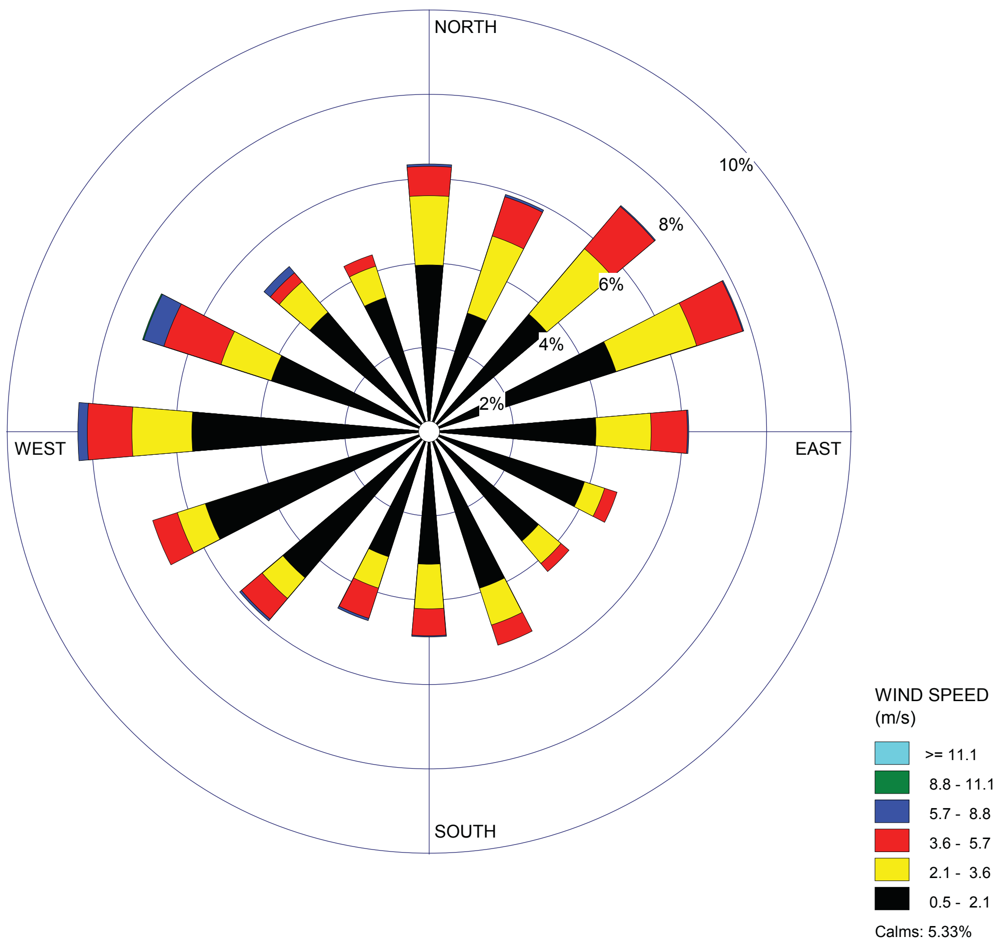

Figure 2.3-11 VEGP 60-m Level Summer Wind Rose (1998-2002)

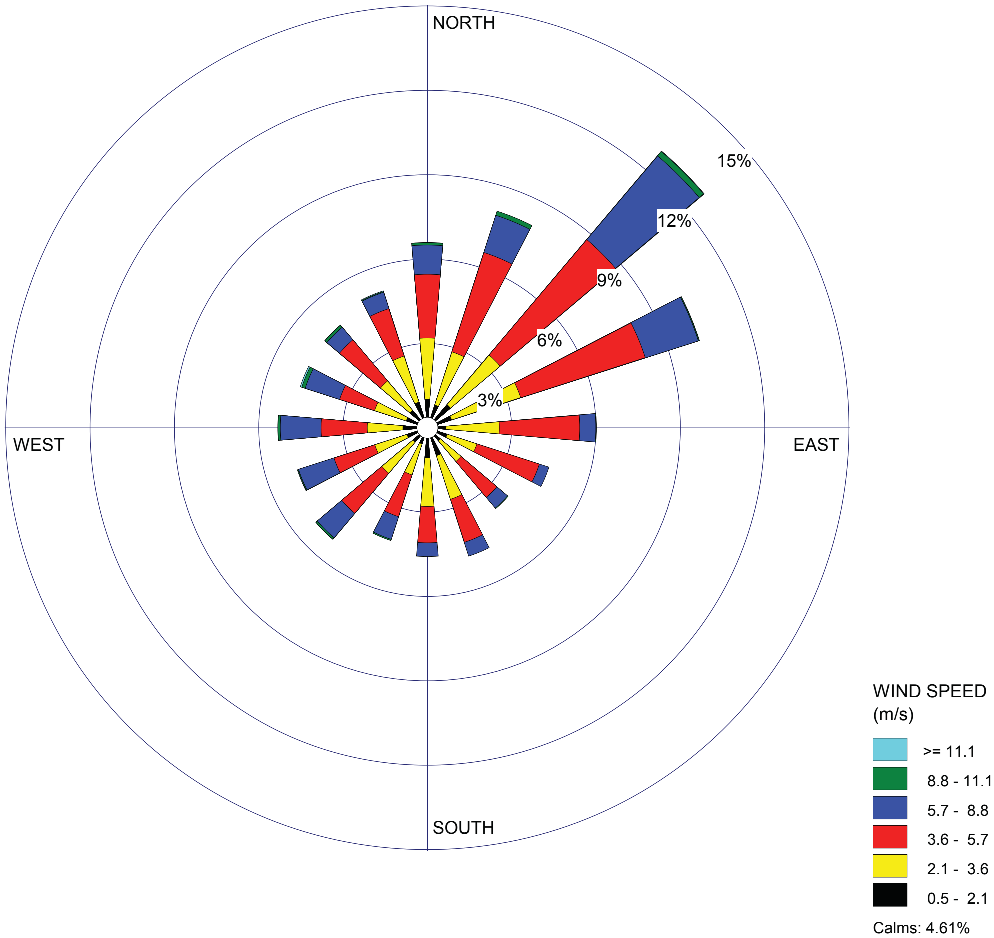

Figure 2.3-12 VEGP 60-m Level Autumn Wind Rose (1998-2002)

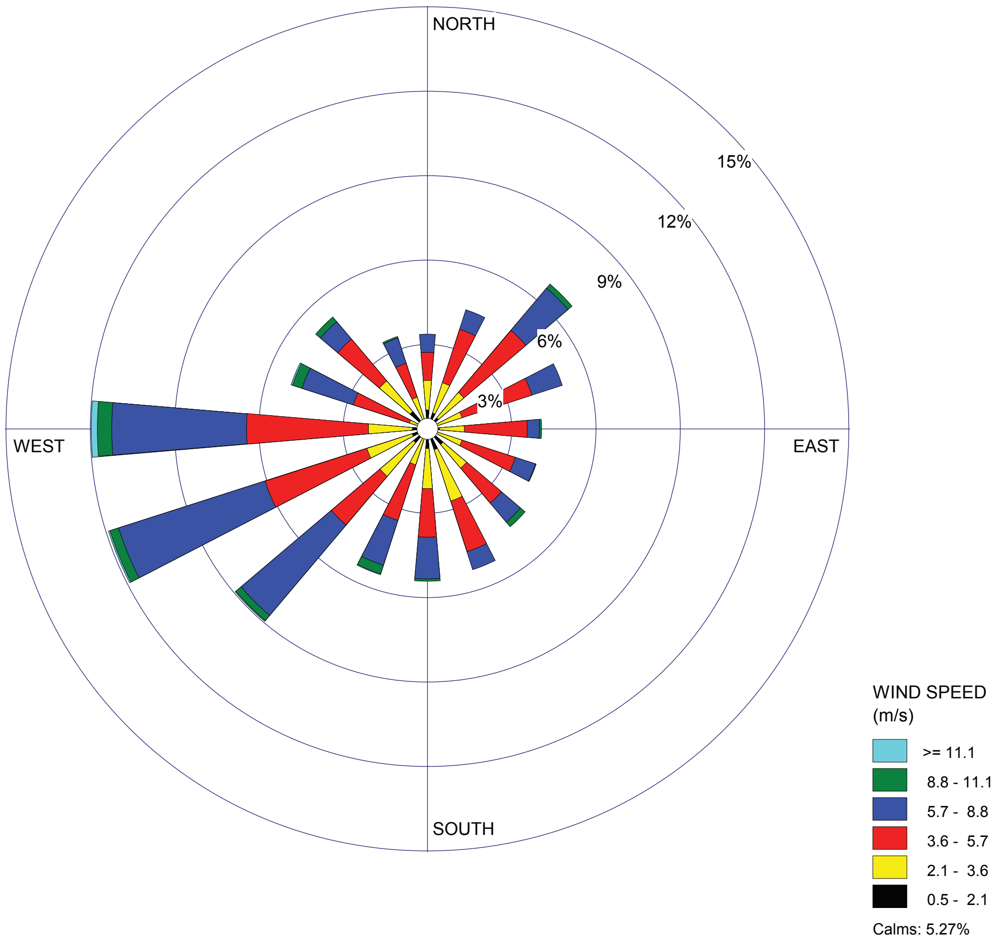

Figure 2.3-13 VEGP 60-m Level January Wind Rose (1998-2002) (Sheet 1 of 12)

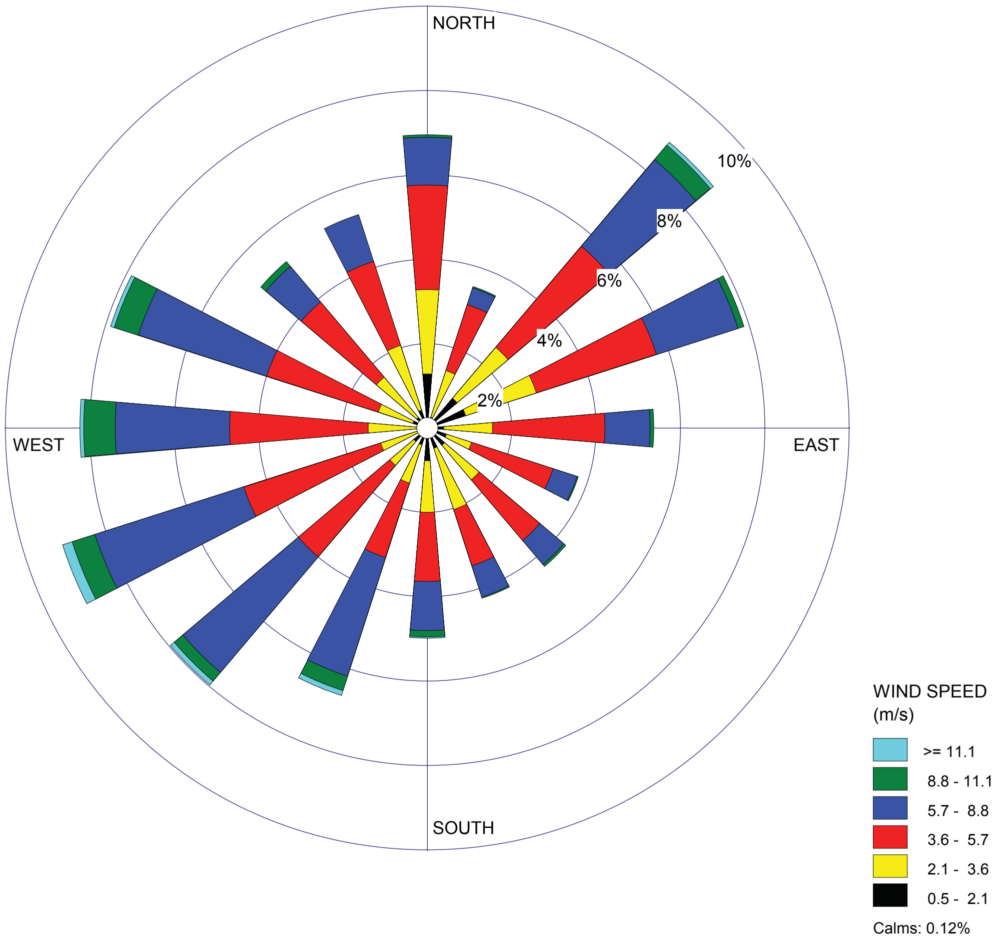

Figure 2.3-13 VEGP 60-m Level February Wind Rose (1998-2002) (Sheet 2 of 12)

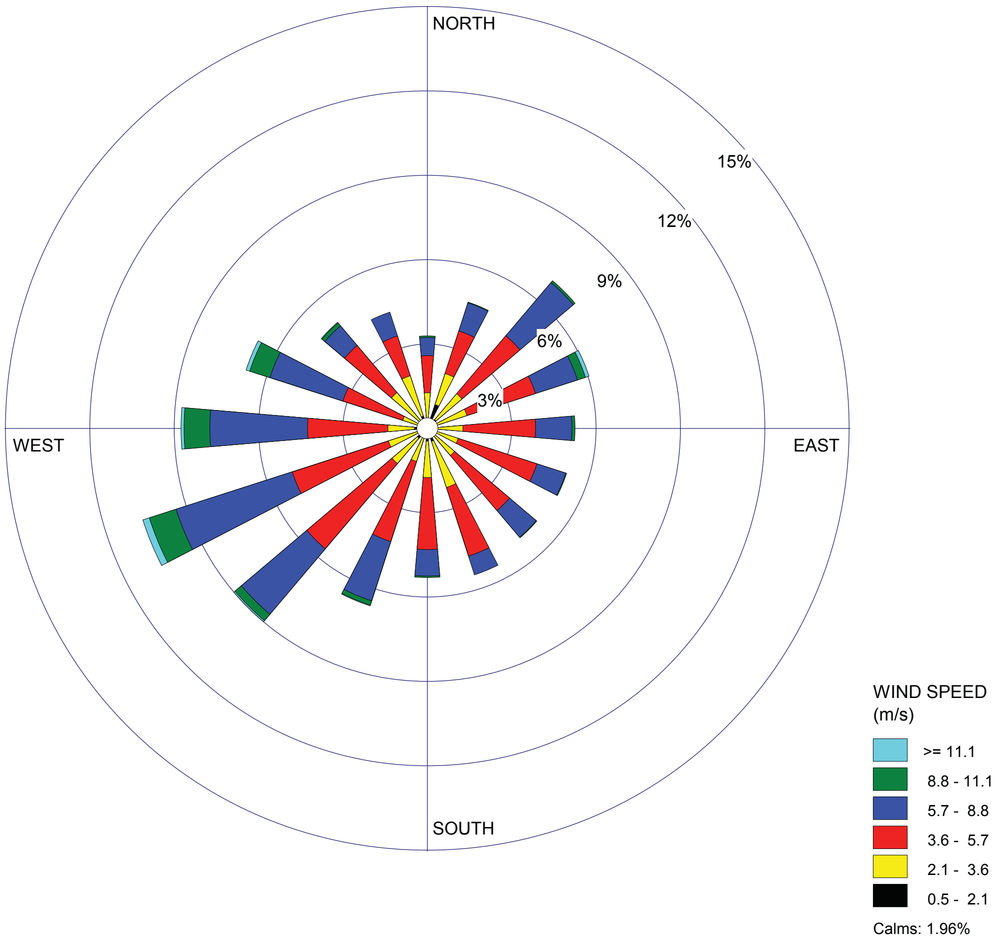

Figure 2.3-13 VEGP 60-m Level March Wind Rose (1998-2002) (Sheet 3 of 12)

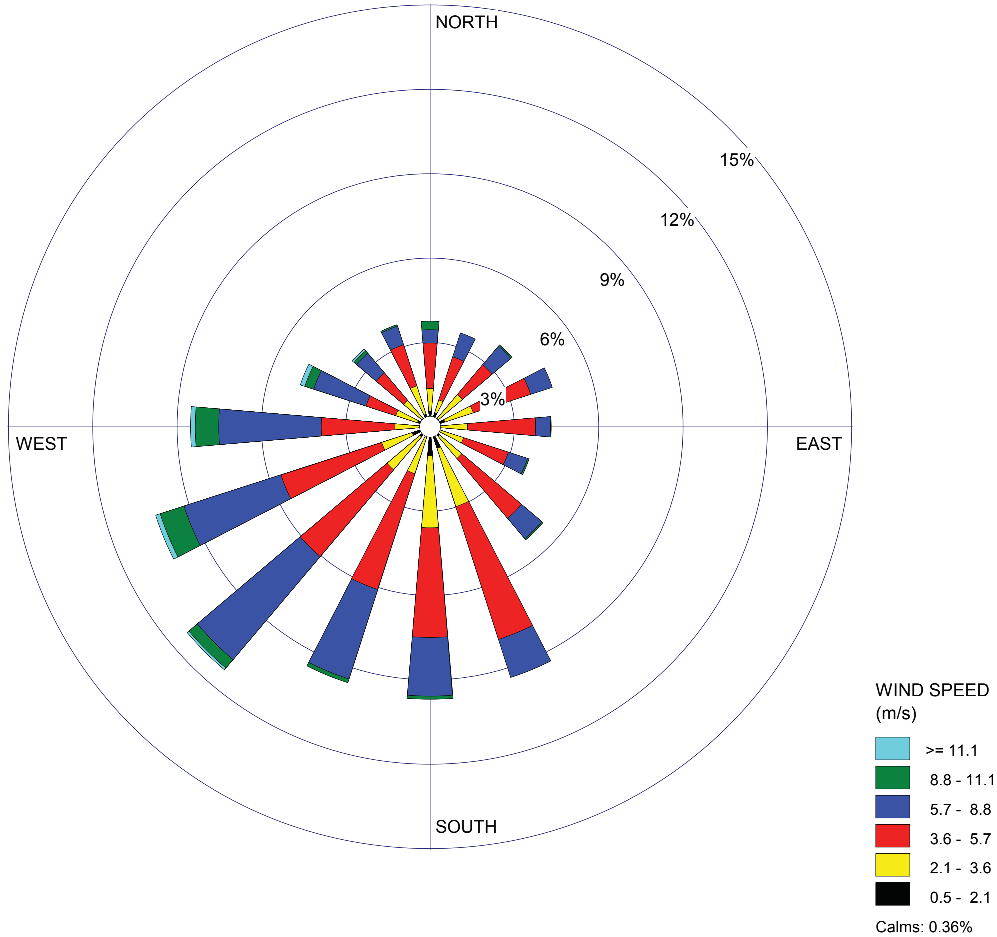

Figure 2.3-13 VEGP 60-m Level April Wind Rose (1998-2002) (Sheet 4 of 12)

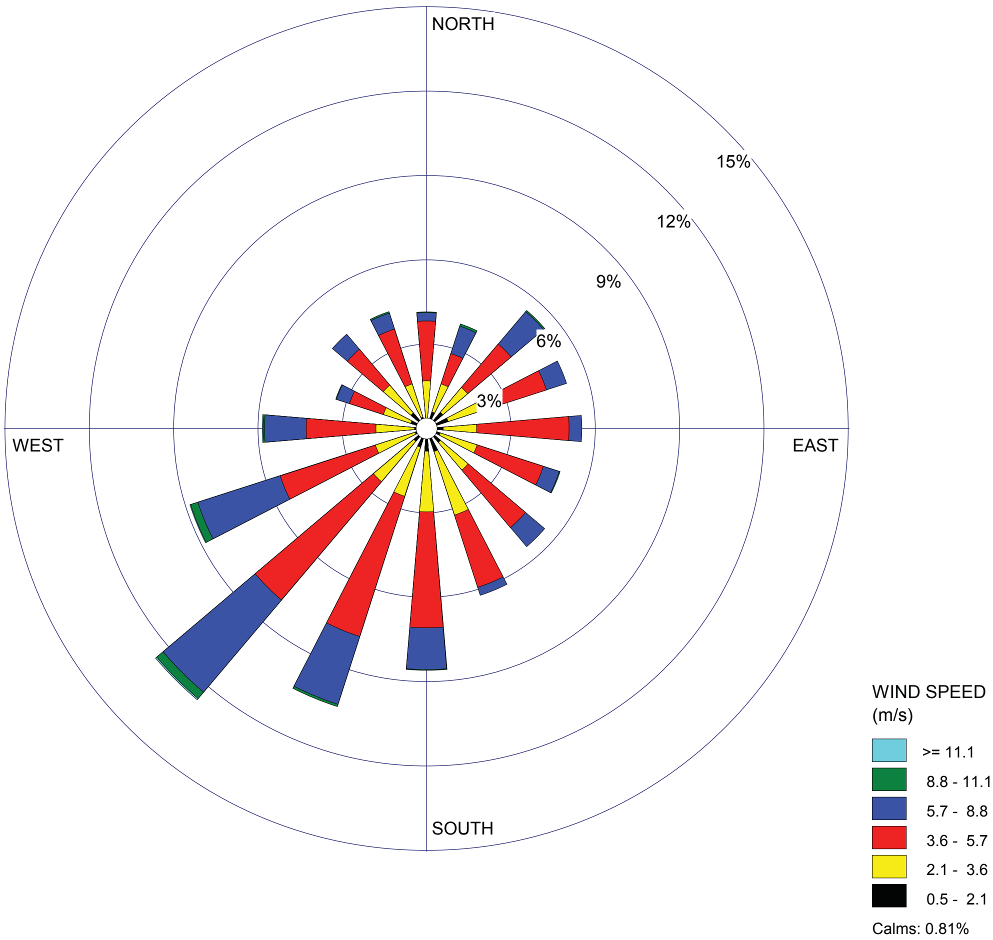

Figure 2.3-13 VEGP 60-m Level May Wind Rose (1998-2002) (Sheet 5 of 12)

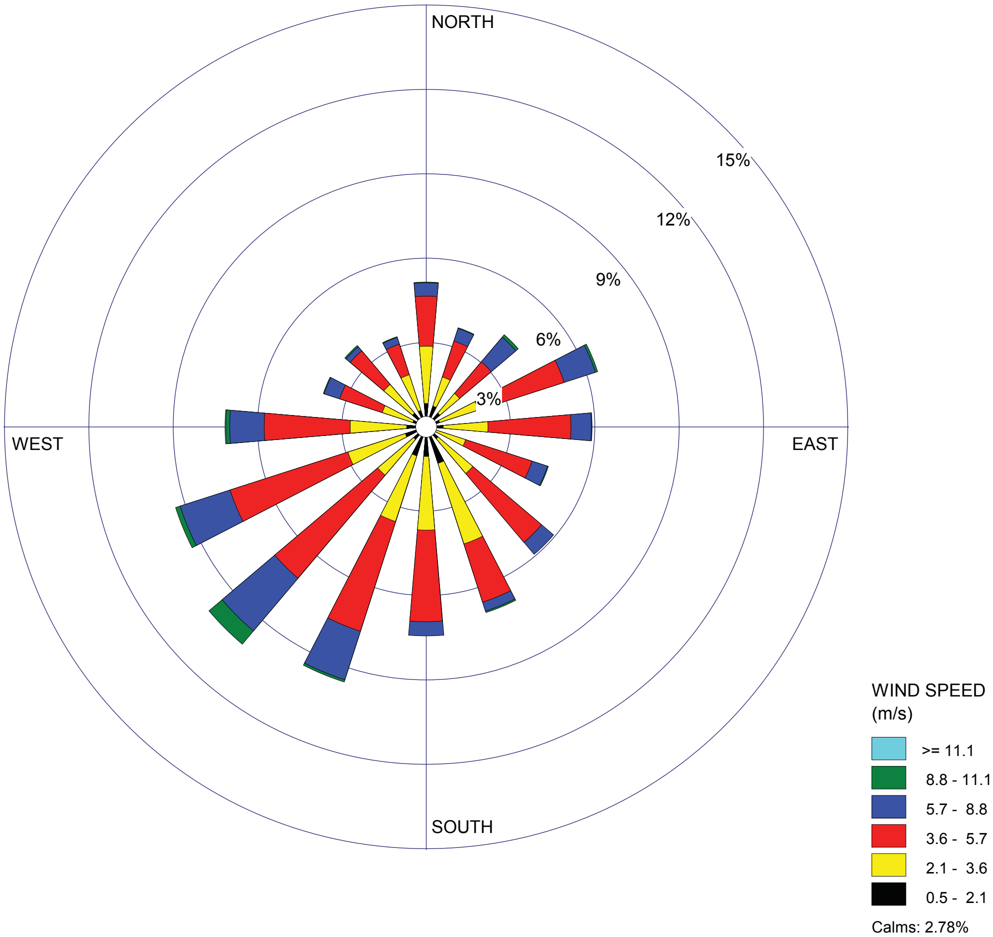

Figure 2.3-13 VEGP 60-m Level June Wind Rose (1998-2002) (Sheet 6 of 12)

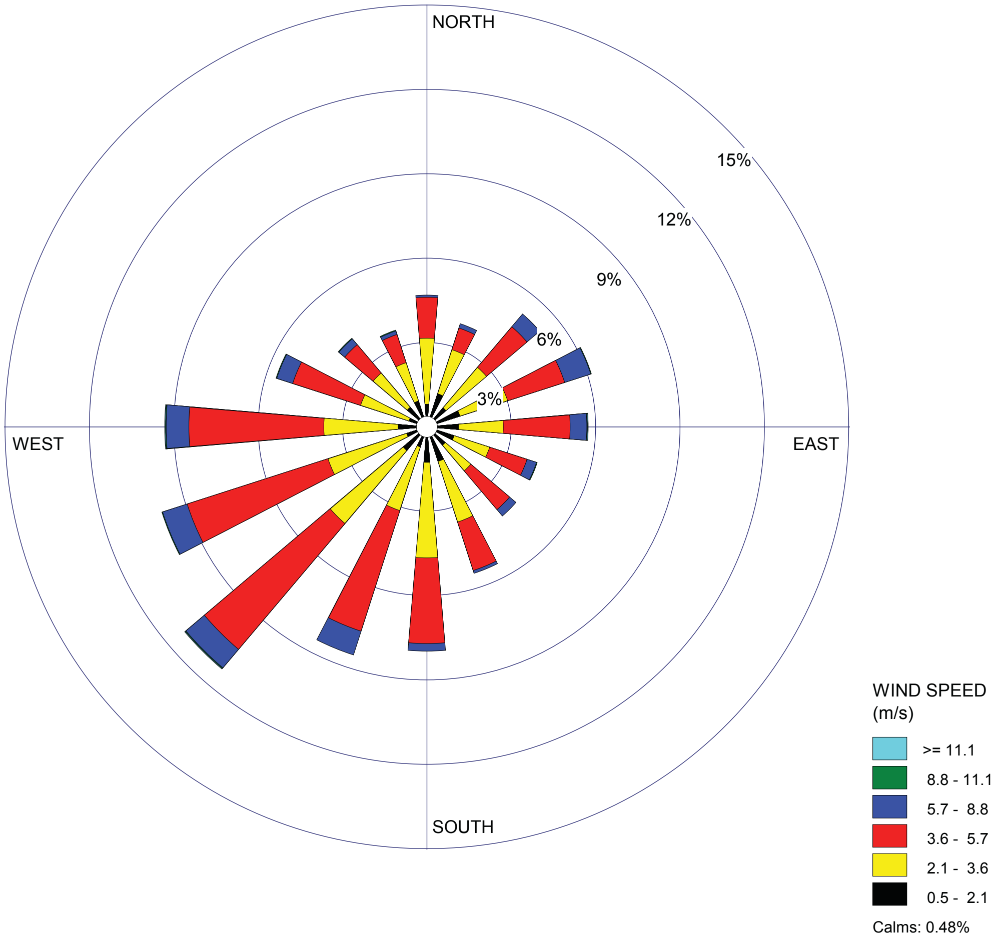

Figure 2.3-13 VEGP 60-m Level July Wind Rose (1998-2002) (Sheet 7 of 12)

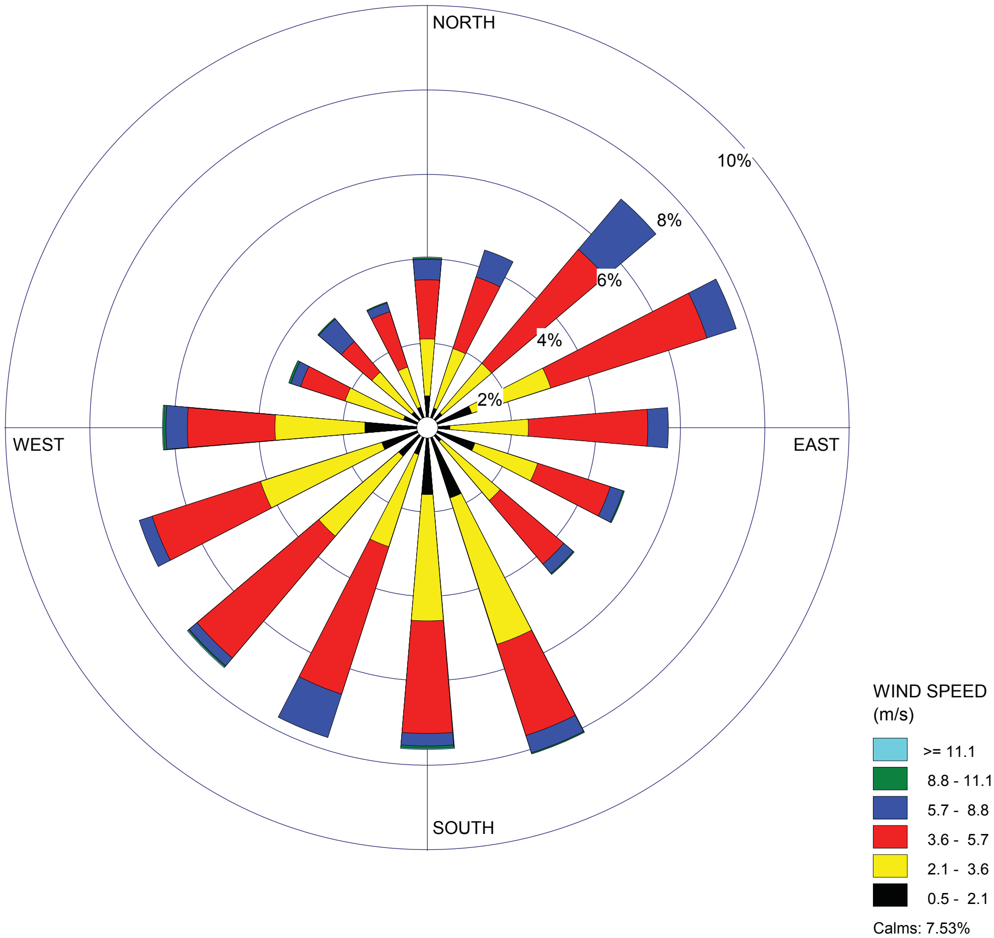

Figure 2.3-13 VEGP 60-m Level August Wind Rose (1998-2002) (Sheet 8 of 12)

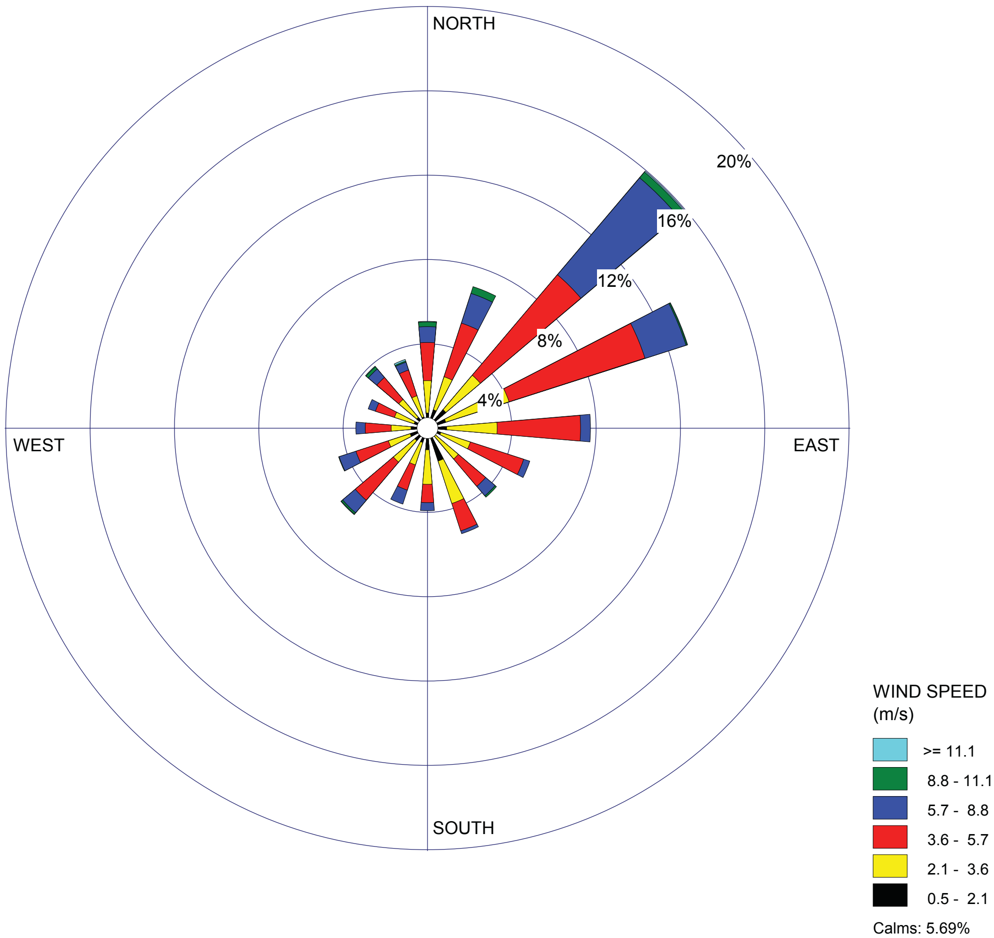

Figure 2.3-13 VEGP 60-m Level September Wind Rose (1998-2002) (Sheet 9 of 12)

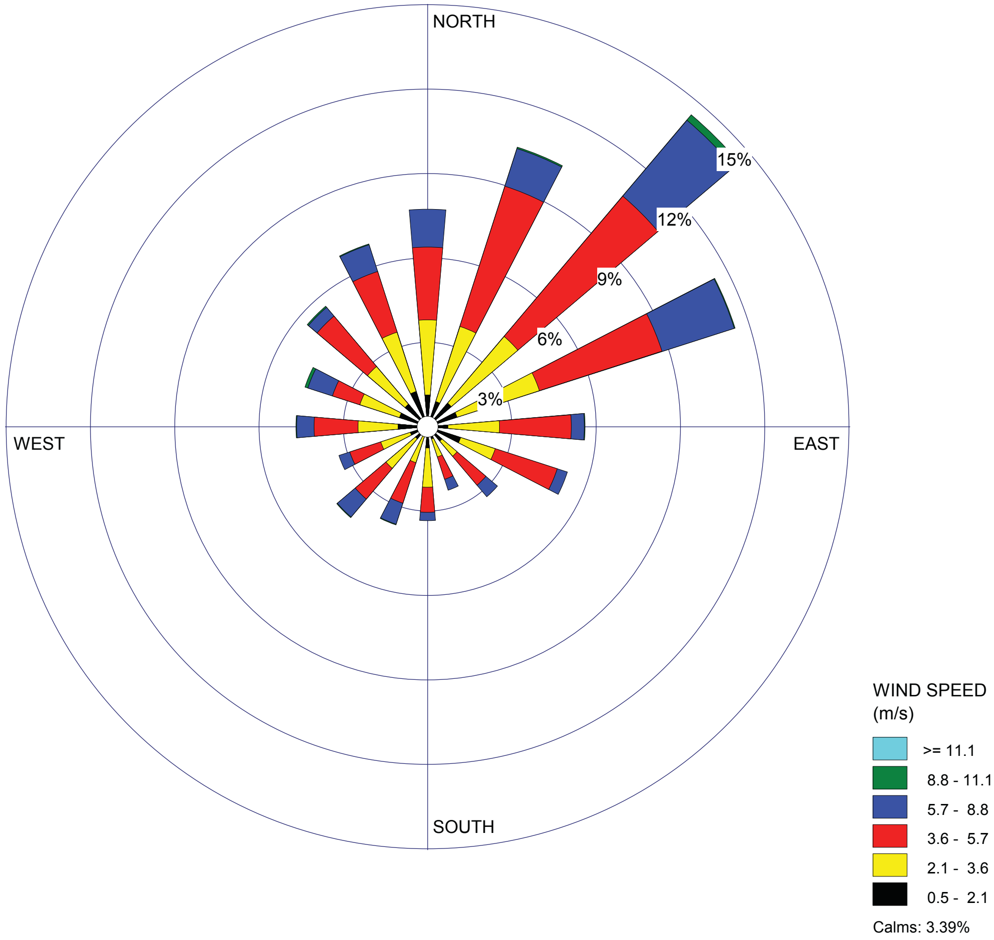

Figure 2.3-13 VEGP 60-m Level October Wind Rose (1998-2002) (Sheet 10 of 12)

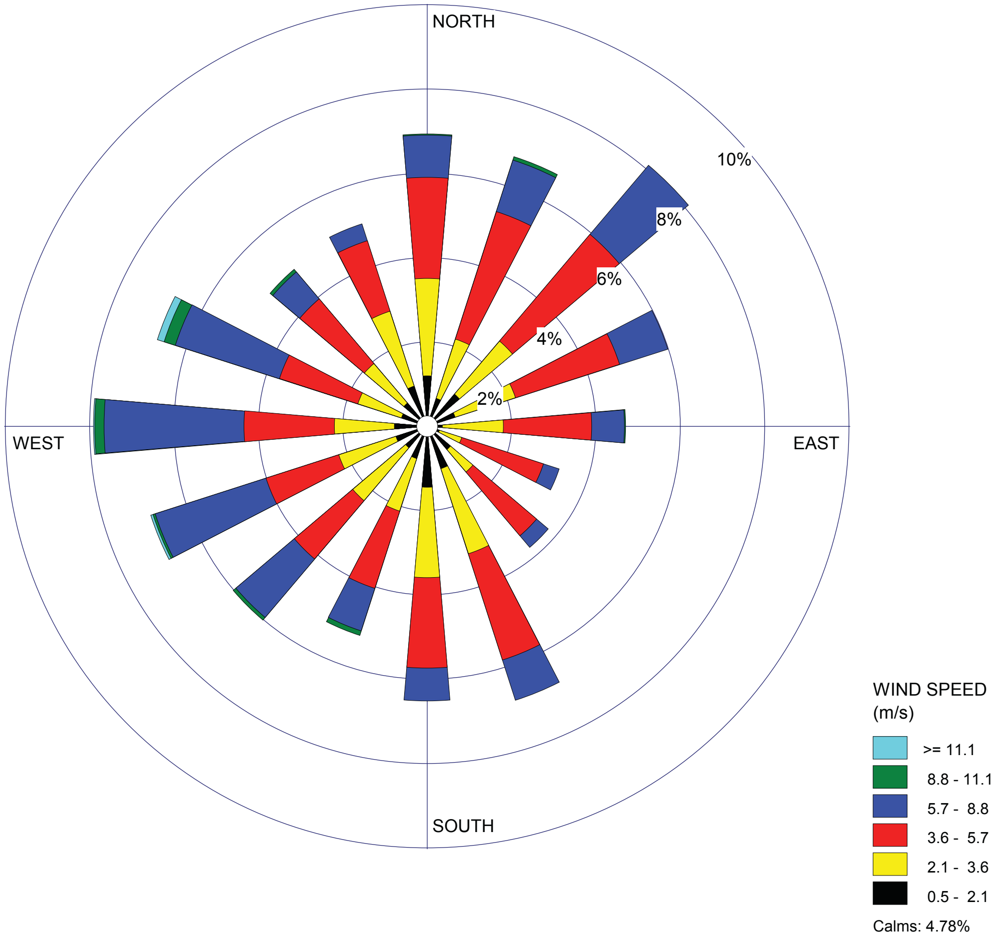

Figure 2.3-13 VEGP 60-m Level November Wind Rose (1998-2002) (Sheet 11 of 12)

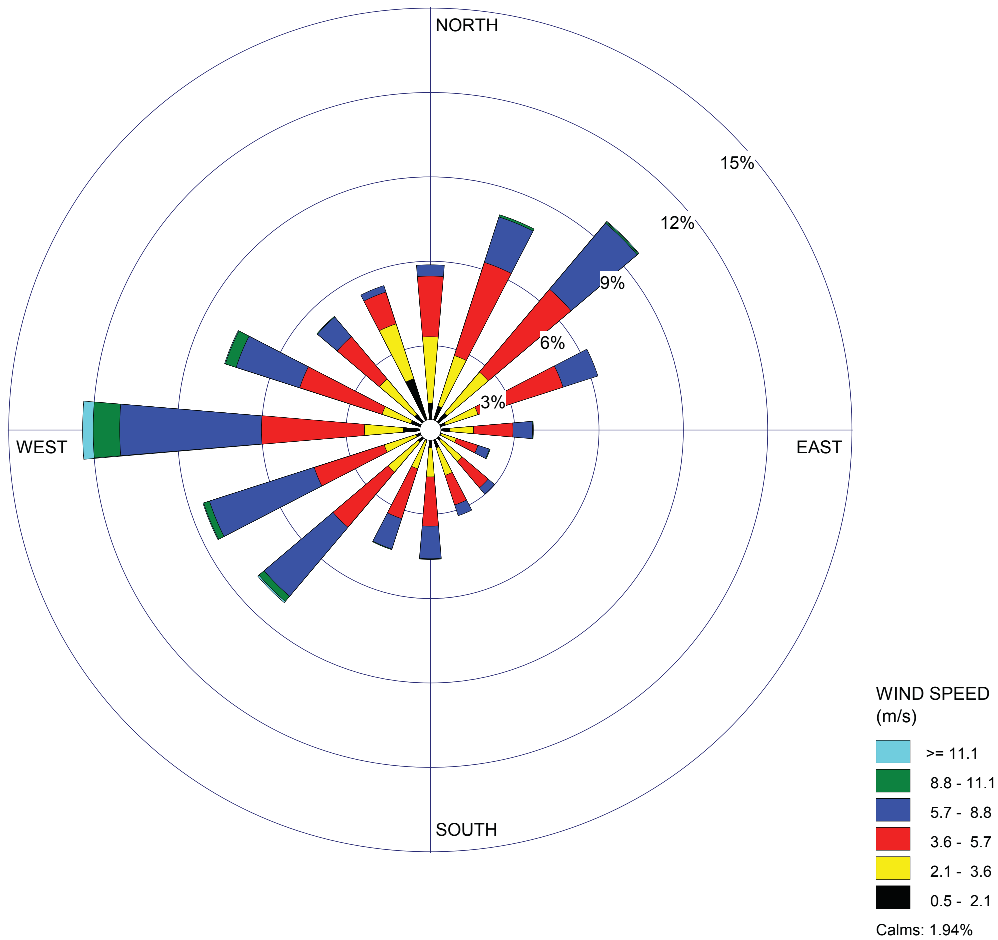

Figure 2.3-13 VEGP 60-m Level December Wind Rose (1998-2002) (Sheet 12 of 12)

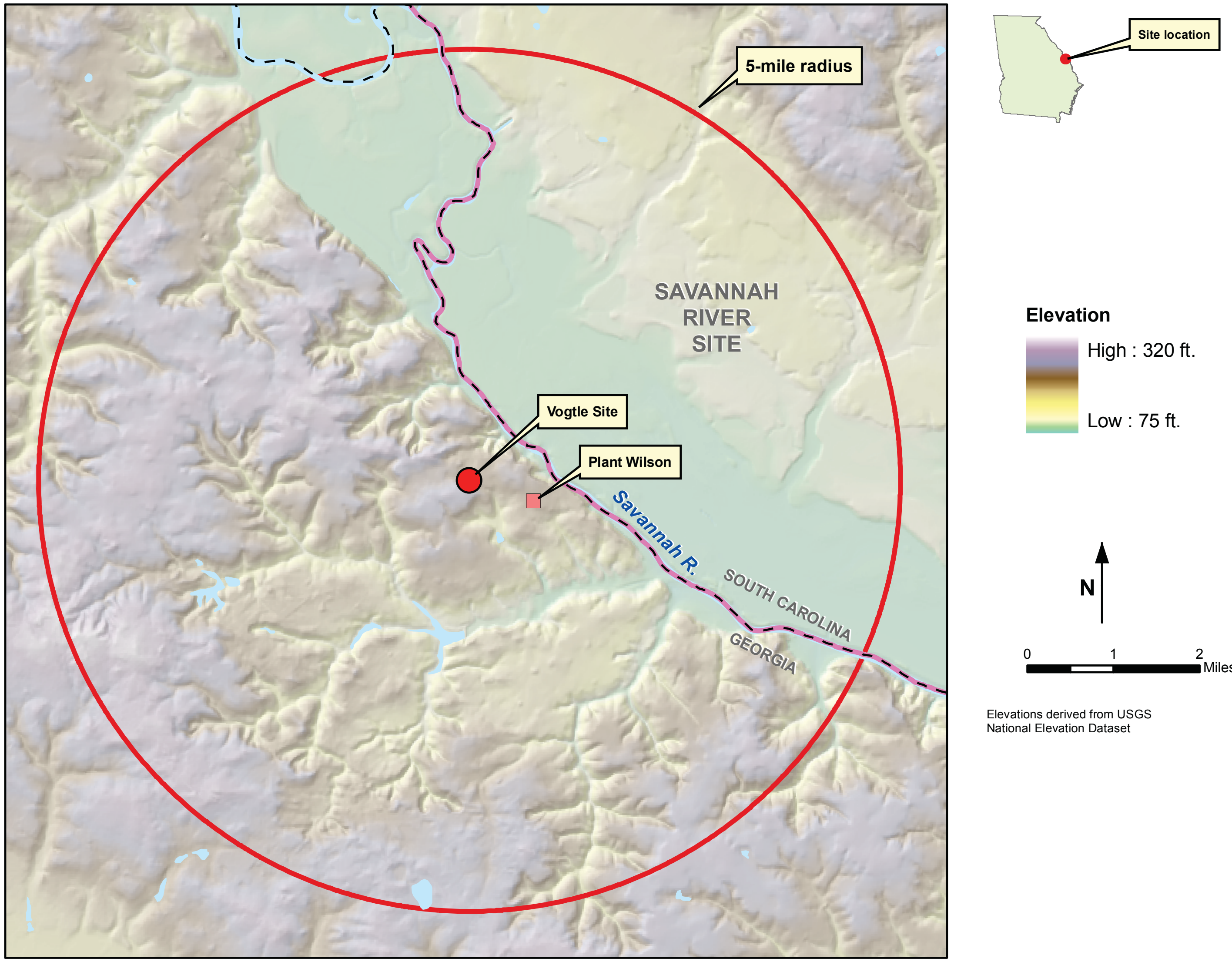

Figure 2.3-14 Topographic Features Within a 5-Mile Radius of the VEGP Site

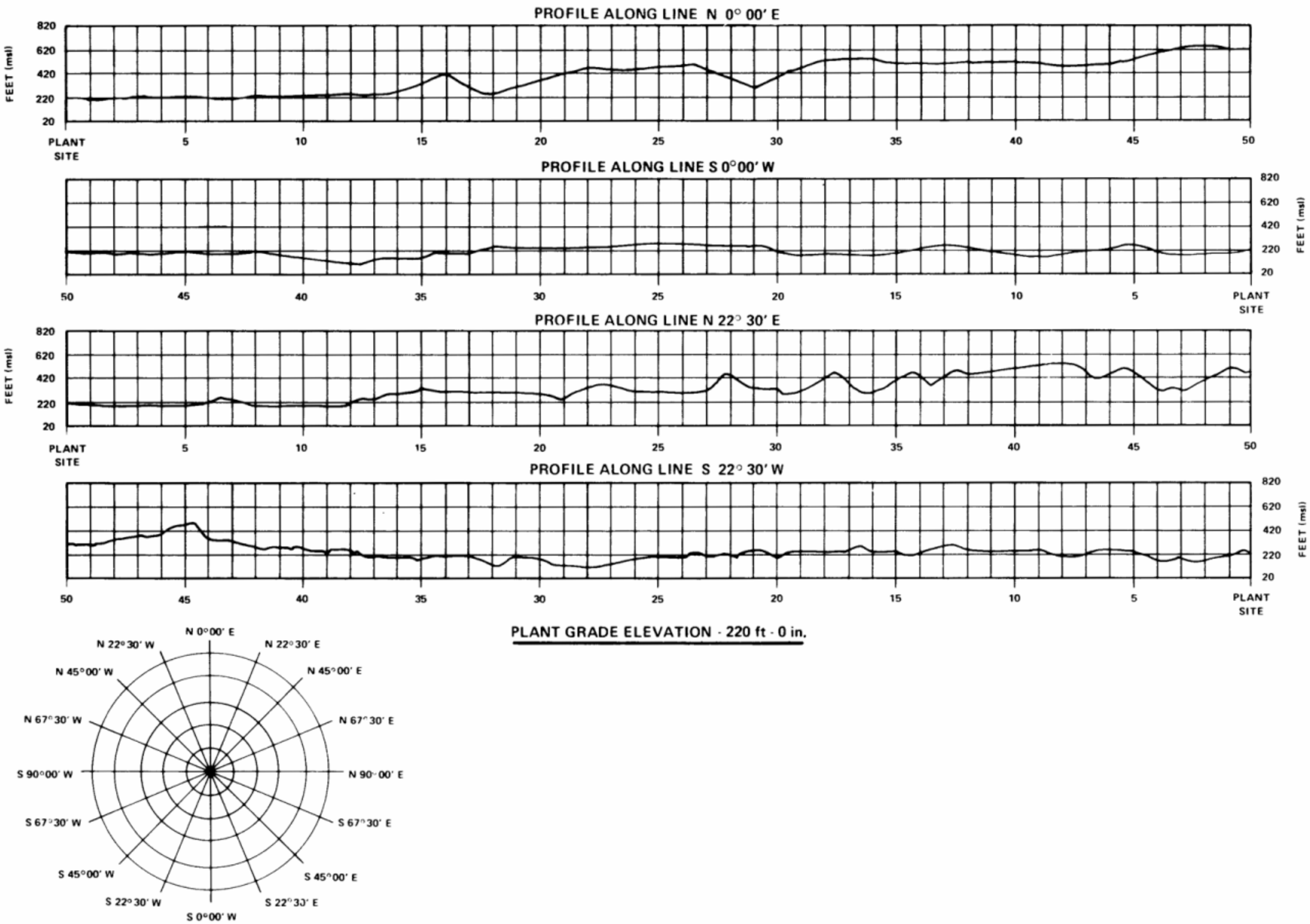

Figure 2.3-15 Terrain Elevation Profiles Within 50 Miles of the VEGP Site (Sheet 1 of 4)

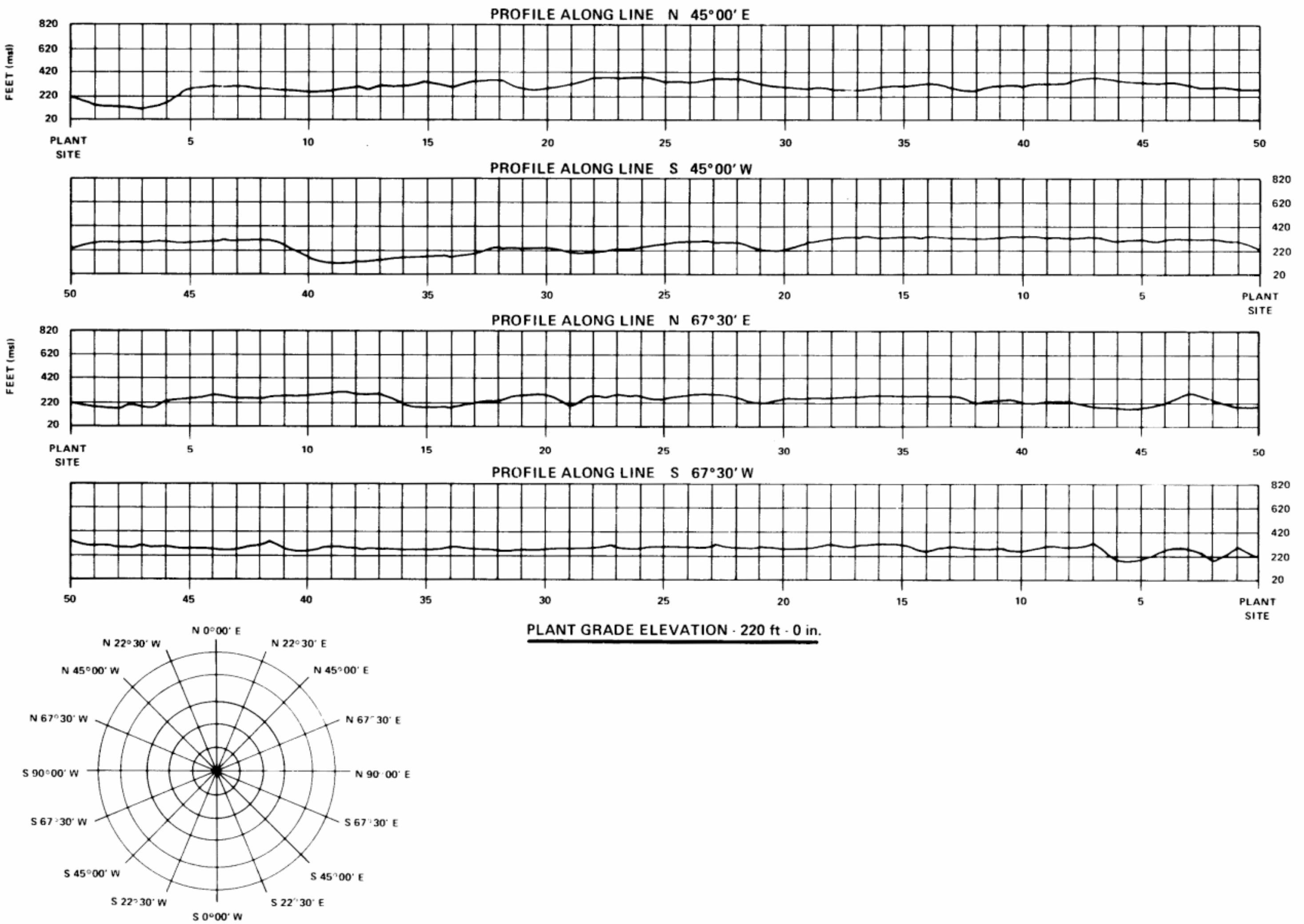

Figure 2.3-15 Terrain Elevation Profiles Within 50 Miles of the VEGP Site (Sheet 2 of 4)

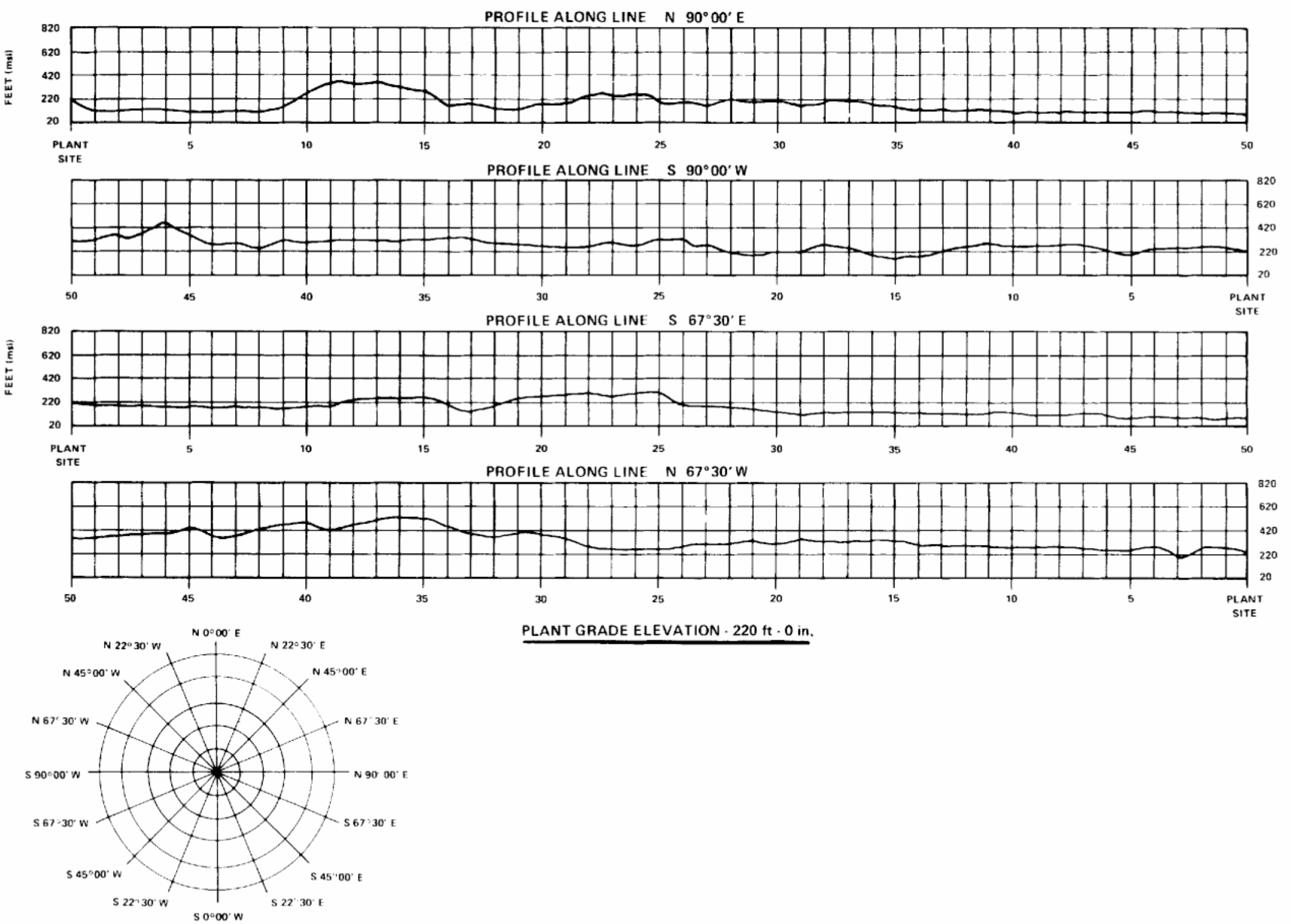

Figure 2.3-15 Terrain Elevation Profiles Within 50 Miles of the VEGP Site (Sheet 3 of 4)

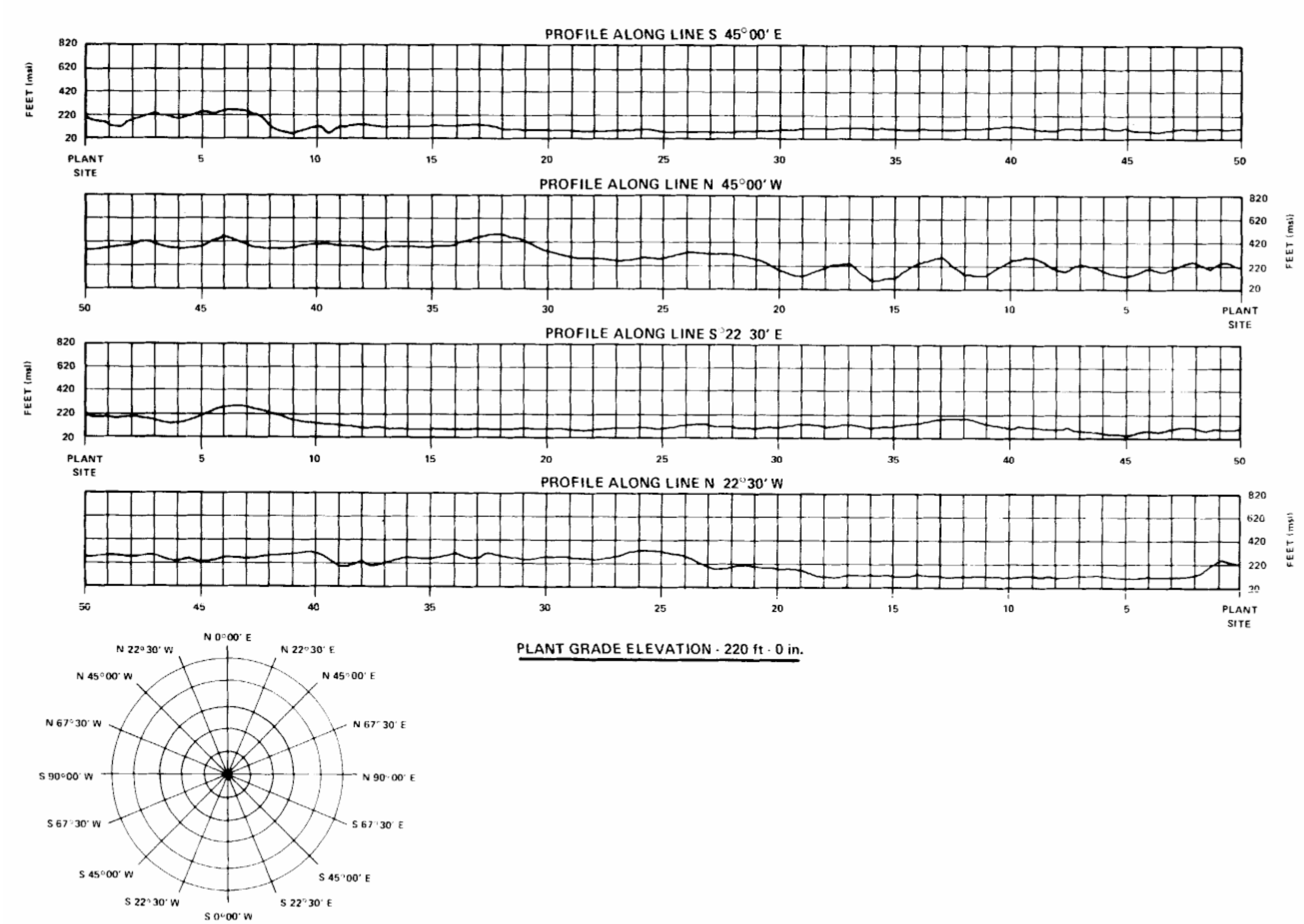

Figure 2.3-15 Terrain Elevation Profiles Within 50 Miles of the VEGP Site (Sheet 4 of 4)

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